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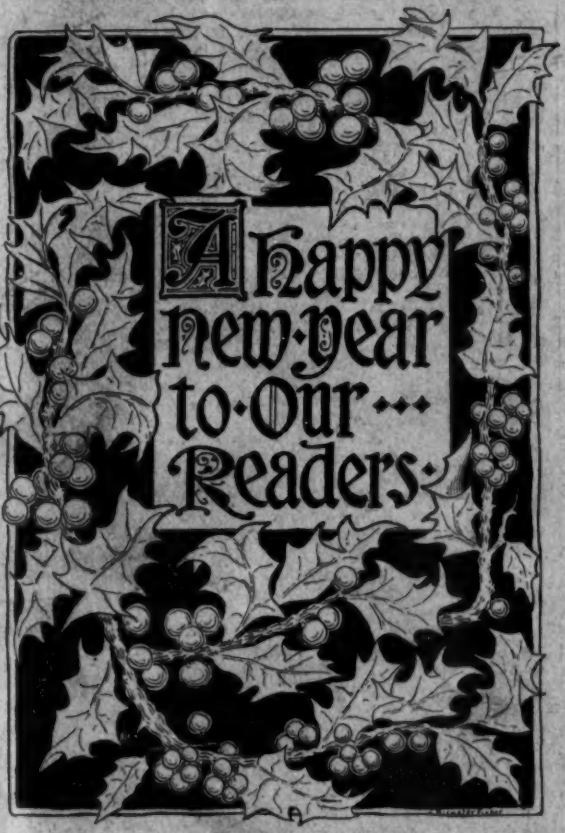

CONTENTS

OF THE

JANUARY NUMBER.

MR. HERBERT SPENCER .. 319
BY MANY HANDS .. 321
N.U.T. NOTES .. 322
NOTES FROM THE NORTH .. 324
THE PROGRESS OF EDUCATION IN EGYPT .. 326
NATURE KNOWLEDGE. By James Kennett, M.A., B.Sc. .. 329
OUR ILLUSTRATED GEOGRAPHICAL NOTEBOOK .. 330
HOW TO MOUNT BIRDS FOR THE SCHOOL MUSEUM .. 332
NOTES OF LESSON ON ROAD-MAKING .. 334
"THE TEACHING OF ENGLISH IN THE ELEMENTARY AND THE SECONDARY SCHOOL" .. 335
INDOOR OBSERVATIONS ON THE SUN .. 336
PRACTICAL HELP IN THE ARITHMETIC LESSON. By George Collar, B.A., B.Sc. .. 337
PHYSICAL TRAINING. A Progressive Course for Elementary Schools. By H. Bipton-Seymour, A.C. .. 339
A SERIES OF LESSONS ON A QUARRY .. 340
THREE RECITATIONS FOR INFANTS .. 341
A CHINESE KINDERGARTEN .. 342
THE LITTLE NUT-TREE .. 344
"LES TROIS VILLES" .. 345
DIFFICULTIES OF FRENCH IDIOMS AND CONSTRUCTIONS 347
ON FRENCH VERSIFICATION .. 348
FRENCH PRIZE COMPETITION .. 349
LETTRE D'EXCUSES .. 349
OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE. By A. T. Flux .. 350
OUR CERTIFICATE COURSE FOR 1904. By G. Collar, B.Sc. 353
PHYSIOGRAPHY .. 357
CHEMISTRY .. 358
ELECTRICITY AND MAGNETISM .. 359
THEORETICAL MECHANICS .. 360
RADIUM .. 362
OUR QUERY COLUMN .. 364
THE EDITOR'S TABLE .. 366

VOL. XXIV No. 7

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THE
PRACTICAL TEACHER
A MONTHLY MAGAZINE AND REVIEW FOR THE SCHOOL-ROOM AND THE STUDY

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MR. HERBERT SPENCER.

A FEW months ago a contributor to the *Practical Teacher* described how he had seen the aged philosopher enjoying the sunshine as he was slowly wheeled about in a bath-chair at Brighton, and now he has passed away. In February 1894 we gave an account of Mr. Herbert Spencer as one of our great educational reformers, and to many of our readers the great thinker is known only by his *Treatise on Education;* but we feel that there is no need of apology in offering a short account of his life and of the leading points in his philosophy.

Mr. Herbert Spencer was born in the town of Derby on April 27, 1820. As a boy, he received a good general training, with a mathematical and scientific tendency, from his father, who was a teacher of considerable reputation in the county. We may attribute to this early training the rigidity with which his ideas are all reasoned out, and perhaps also the formality of style which renders his writings less acceptable and pleasing than they might have been had he been brought up more upon the traditional literary lines. He also studied under an uncle, the Rev. Thomas Spencer, a clergyman of the Church of England, who lived at Hinton Charterhouse, near Bath. Herbert Spencer did not proceed to one of the universities, but was drawn into the engineering profession, which the development of railways made so attractive towards 1840. But the swing of the pendulum came with the panic of 1847, and though Herbert Spencer was not one of those who lost their capital at that time, yet engineering ceased to have an attraction for him or a demand for his services.

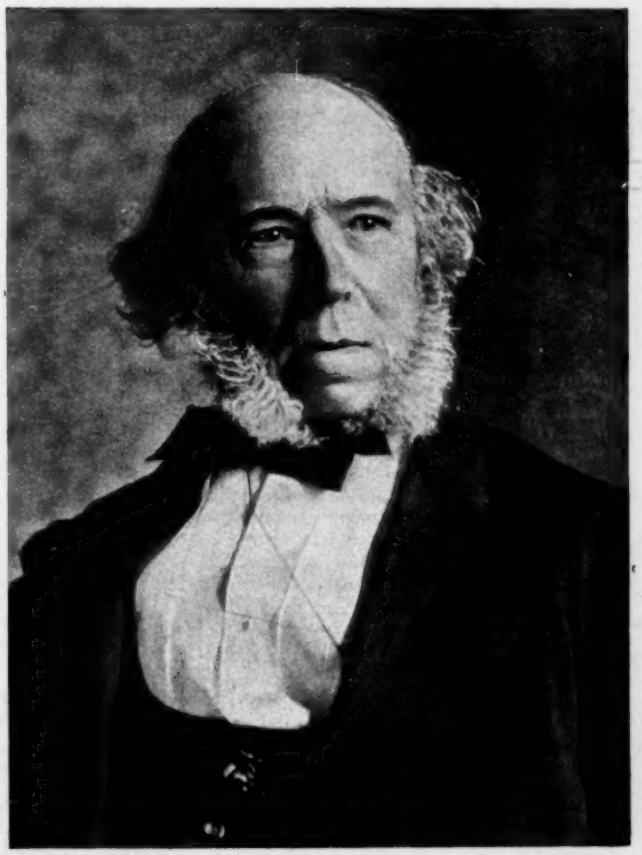

Photo by permission of] MR. HERBERT SPENCER. *[Messrs. Elliott and Fry.*

As a writer, Mr. Spencer made his bow with some technical articles in the *Civil Engineer and Architect's Journal;* but he soon turned his attention to political philosophy, and contributed a series of letters, "On the Proper Sphere of Government," to the *Nonconformist*. He became a regular contributor to the *Economist*, and was at one time its sub-editor. He also contributed to the *Edinburgh Review* and the *Westminster Review*. The staff of the latter comprised some of the best writers and thinkers of the day; and when Mr. Spencer came up to London he received a hearty welcome from them, and obtained an introduction to Carlyle, John Stuart Mill, and George Eliot, which led to a friendship lasting through life, and was productive of marked results on both sides.

One of his close friends was George Henry Lewes, who became the first husband of George Eliot, her second husband being Mr. Cross, another of Mr. Spencer's close personal friends. Although George Eliot was professedly an admirer of the positivist philosophy of Auguste Comte, her writings bear strong evidence of Mr. Spencer's influence.

Apart from his literary work, Mr. Spencer's life was quiet and uneventful. He was of slender build and slightly above the medium height, and our portrait will enable the reader better than any verbal description to form an idea of the man's personal appearance. That he should have lived well into his eighty-fourth year speaks volumes for the regularity of the life he pursued. He was fond of outdoor exercises, and in his prime was an ardent angler. Indoors he was fond of intellectual society, and much enjoyed a quiet game of billiards. He played the game purely for his own amusement, and is said to have spent much time in working out the evolution of the game, and carefully calculated the

motion of the ball by the principles of mechanics. Mr. Spencer was never married, but lived alone for a great part of his life at Bayswater, and afterwards Brighton became his favourite place of residence, and it was at this watering-place that the philosopher breathed his last on December 8th.

Of his philosophy it is impossible to speak without referring to the great movement of which it forms part. The question round which modern thought centres is, "How have things come to be what they are?" And the answer generally given is that they have developed from simpler things, in accordance with certain laws. This change from the simple to the more complex we call evolution. The laws by which organic beings have been evolved formed the life-work of Huxley, and pre eminent among these laws is the law of natural selection, frequently spoken of as the "survival of the fittest." Mr. Spencer showed that this law applied not merely to bodily forms, but also to such intangible things as instincts; and that, for instance, just as some birds were obliged to seek their food in the water, and the development of webbed feet, etc., fitted them for an aquatic life, so others, finding that a better supply of food could be obtained by seeking it further south in winter, became more fitted to survive and perpetuate their species than those who remained in their summer habitat.

Mr. Spencer teaches that this law of evolution is of universal application; that it covers the phenomena of the human mind in all its ways of working; that it accounts for ethics, or our views of good and evil conduct; that it explains not only the action of individual men, but also the growth of institutions—social, religious, and political.

In the field of ethics Mr. Spencer teaches that there is a "continuous adjustment of internal relations to external relations," just in the same way that animals and plants are subject to a liability to variation to suit their environment. Hence he concludes that that conduct is right which most helps forward the adaptation to environment. On the one hand this view has the advantage of universal application. Mr. Spencer even speaks of the "conduct of molluscs," and holds that those actions which help on the adjustment of life to circumstances are good and right. At the same time he does not regard present conditions as final but as transitional and leading on to a state of perfection, so that he propounds a system of ethics which is quite independent of the present world, and relates to a world in which the adjustment to environment shall be complete. In general he is in accord with the Hedonistic philosophers, or those who make pleasure the measure of virtue. He writes:—

"I conceive it to be the business of moral science to deduce from the laws of life and the conditions of existence what kinds of action necessarily tend to produce happiness, and what kinds to produce unhappiness. Having done so, its deductions are to be recognized as the laws of conduct."

The study of "the laws of life and the conditions of existence" led Mr. Spencer to come to the conclusion that there is a standard or ideal of character which depends upon the perfect adaptation to environment or "the continuous adjustment of internal relations to external relations," and by the recognition of the fact that actions which tend to bring about this perfect adaptation are attended by pleasure. Mr. Spencer's views are in accord with those of the Hedonistic school of philosophy. Mr. Spencer has endeavoured to place both virtue and pleasure in their proper relation to the great scheme of evolution, and to show that there must necessarily be an intimate relation between a virtuous act and the feeling of pleasure which accompanies it. He showed that the coincidence between the feeling of pleasure and the virtuous acts must be due to "natural selection;" for since virtue consists, as we have said, in the adaptation to environment, those beings which had a tendency to pleasurable feelings when working towards that end would be led to act so as to adapt themselves, and thus would have an advantage in the struggle for life over those to whom such conduct was irksome.

In the same way Mr. Spencer deals with the questions of egoism and altruism—that is, between the idea that each person should seek what is productive of the greatest benefit to himself and the idea that he should aim entirely at promoting the good of others. By the theory of evolution he shows that there must be a certain proportion or equilibrium between the two. For, if each person looked only after his own good, parents would cease to provide for their children, and the race would soon die out; and, on the other hand, if a person were to be so devoted to others that he neglected to take those precautions which are necessary for his own safety, the same result would follow.

We might show also how Mr. Spencer applies the evolutionary theory to the study of the emotions, and connects the emotions with movements accompanying actions to which the emotions lead. "That the propensities," he says, "to the acts are nothing else than nascent excitations of the psychical state involved in the acts is proved by the natural language of the propensities. Fear, when strong, expresses itself in cries, in efforts to escape, in palpitations, in tremblings; and these are just the manifestations that go along with an actual suffering of the evil feared. The destructive passion is shown in a general tension of the muscular system, in gnashing of teeth and protrusion of claws, in dilated eyes and nostrils, in growls; and these are weaker forms of the actions that accompany the killing of prey. To such objective evidences every one can add subjective evidences. Every one can testify that the psychical state called fear consists of mental representations of certain painful results; and that the one called anger consists of mental representations of the actions and impressions which would occur while inflicting some kind of pain." He follows this theory up in its details, and sees in the dilation of the nostrils of a man in anger a distant repetition of the way in which the man's remote ancestors had to breathe when their "mouth was filled up by a part of an antagonist's body that had been seized."

We might follow up and illustrate this theory almost indefinitely, but space forbids, so we will conclude with a few remarks on the *Treatise on Education*. In a collection of circumstances it is always difficult to pick out one as the determining cause which has produced a given result, but there can be no doubt that this book has had much to do with the introduction of science into the curriculum of our schools. The part dealing with the subjects that should be taught may, in fact, be regarded as a special plea for the teaching of science. Like every reformer, he indulges in excess in his advocacy; and hence, although he states that "acquirement of every kind has two values—value as *knowledge* and value as *discipline*"—he lays great stress on the utilitarian value of the *knowledge*, and not enough upon the *disciplinary* value of the study. The third chapter is open to rather serious objections, if the theory of natural punishment is to be carried to its logical conclusion. It is a natural law that the consequences of an evil act may often be the most suitable punishment for it, and within certain limits parents and others should endeavour "to make the punishment fit the crime." Natural consequences are, in the first place, frequently horribly disproportionate to the offence. Consider four disobedient children who go and play with their fathers' razors: one may cut himself so seriously as to bleed to death, another may just get a slight scratch, the third may receive no harm at all, while the fourth may not only receive no harm himself, but may gain a great deal of pleasure by damaging the drawing-room furniture. Yet the disobedience may be of the same degree of guilt in each case. Then, again, the result may be only remotely connected with the cause. Every teacher knows how difficult it is in many cases to induce children to apply themselves to their lessons by referring to consequences in after-life, and moreover when those consequences come it is too late to reform, and reformation should be one of the objects of punishment.

It seems also to us that Spencer is not quite true to his own principles, for we must recognise that the child is a member of a society which has gained a large amount of collective experience, and we should allow the child to adapt himself to his environment in this particular, if we are to follow out the teaching of the great philosopher. We do not intend these remarks as adverse criticisms on the treatise, but give them rather as cautions, in the hope of making the book more useful still. It is certainly one with which every teacher should make himself quite familiar.

BRITISH MUSEUM

BY MANY HANDS.

"Quot homines, tot sententiæ."

LITTLE by little the civilisation of the antique world is being laid bare, and one of these later revelations, described by Maspéro, the eminent Orientalist, in a recent issue of the *Journal des Débats*, is surely among the most interesting. It is nothing more nor less than the reconstitution of a Babylonish school from the results of excavations made at Sippara—Sippara of the plain—one of the cities of the Euphrates valley. A little house of seven rooms, almost opposite the temple of Sippara, was discovered, and after twelve feet of rubbish had been removed, it proved to have been the school. In one corner a library had been formed by an enclosure of baked brick. This was full of Babylonish school books—that is, tablets of terra-cotta. On these in destructible books could be read the hymns, lists of weights and measures, spelling exercises, vocabularies, and rules of arithmetic studied ages ago by the little Babylonians. Many were text-books; for the inscriptions were made so carefully and beautifully that they had evidently served as models. Others were the exercises of the scholars—the budding scribes of Sippara. Imagine it—a Babylonish copy-book!

A Babylonish School—

THE mere name is of great interest; but add to that the fact that these text-books and exercises date from the twenty-first century before the Christian era! What school exercises of to-day can hope for such an immortality? The excavator, Vincent Sheil, was able, from the tablets discovered in this school library, to reconstruct the curriculum of the school of Sippara; and making allowance for the difference of civilisations, it curiously resembled the curriculum of to-day. We have not space to recount it fully, but one thing strikes us as being of peculiar interest. One of the great bugbears of the youthful scholar of the twentieth century A.D. is spelling. What must it have been to his *confrère* of the twentieth century B.C.?

—and its Curriculum.

FOR he had to learn to write in cuneiform—that is, a language in which the characters are composed of a number (sometimes large) of straight lines and angles arranged in all possible directions and at all possible angles. But when he had memorised all the characters, our little scribe of Sippara had only begun. For these had at least half a dozen different values—acting sometimes as syllables, sometimes as ideograms, according to the combination in which they occurred. So that when he had learned the characters, he had to recommence and learn their values when single and when in combination before he could hope to decipher a single line of the Babylonish script. English spelling, in itself a new labour of Hercules, pales before this cuneiform task, from which we get a glimpse of the reason for the extraordinary esteem in which the scribe was held by the people of this civilisation of forty centuries ago.

Cuneiform Copy-Books.

HAD the Babylonians been a paper-using people, what a tremendous consumption of paper must have occurred! But they managed better. Armed with a stylus of wood, bone, or copper, and provided with a clay tablet, the young scribe was furnished with writing materials which would outlast a ream of copy-books. For after filling his exercise book and submitting his cuneiform copy to the master, he passed a spatula over the surface of the tablet, and there it was, ready for use again and again. Did he wish to preserve his exercise, it was quite simple. He *baked* his book, and after forty centuries it is still in existence! In this school library were grammar books—in cuneiform—arithmetic exercises in Babylonish avoirdupois and square measure, and religious texts. But the bulk were devoted to the task of teaching the language—its script and its spelling; and one contained a copy-book-heading maxim which we commend to the strugglers after excellence in calligraphy and orthography—"He who excels in the writing school shall shine like the sun."

Baked Exercises.

ONCE again ancients and moderns are to close in deadly strife. When the congregations met at Cambridge, the senate was asked to approve (*and did so!*) the formation of a syndicate "to consider what changes, if any, are desirable in the studies, teaching, and examinations of the university." "Compulsory Greek" is one of the things in the eye of the proposers, and we can well imagine that the partisans of the classics are whetting their weapons for the "Battle of the Books" which is sure to occur. In the result of that fight every one who is really concerned about education must be interested; for an improvement of English secondary education can, we believe, only be effected by the reorganisation and modernising of the highest education. The universities set the fashion to, and control, the secondary schools. Wherefore to us it seems that the educational problem, so far as it affects these schools, is not to be solved by any levelling-up process, but rather by working from the head (the universities) downwards.

Stirring the Dry Bones—by Cam—

IT is in the recognition of this fact—the vital importance of the organisation and perfection of the means of higher education in all branches, literary, scientific, and technological—that the Americans have shown their greatest acuteness and made their biggest advances. But we do not despair of England yet. The Cambridge proposal is a sign of the times, just as a book published recently, *Oxford at the Cross Roads*, indicates a stirring among the dry bones by Isis. For that book, though ostensibly a plea for the better treatment of the writer's subject—classical archæology—is in reality a criticism of the attitude of the university towards modern branches. "Times change, and we with them," says the Latin tag. But do we? In the *Edinburgh Review* for 1809 appeared Sidney

And Isis.

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Smith's article on "Professional Education," in which he attacked the classical system of our great schools and universities. Much of it might be used again for the same purpose to-day; yet that was written four years after the battle of Trafalgar!

MANY experimental researches into the mental fatigue caused by class work have been made, chiefly by means of the ergograph or the æsthesiometer. These instruments, in spite of their names, are quite simple. They are merely compasses, the latter of great delicacy. By measuring on the cheek or forehead the distance at which the pressure of the two points is appreciated as two distinct sensations when the eyes are closed, the experimenter arrives at a test of the condition of the subject's nervous reaction to impression—in other words, the distance between the two points constitutes a measure of nervous tension in the subject. If applied after periods of strain—as, for example, a period of study—the change in the distance between the points of the æsthesiometer is the indication of the greater or less drain of nervous energy caused in the student. It will be seen that this form of experimental psychology is simple in the extreme, and requires only careful use and extended application in order to furnish materials from which valuable inferences may be drawn.

The Ergograph—

APPLIED extensively in America to students and school children, some interesting results leap out from the recorded observations. For instance: that four to five hours of study diminishes the sensibility of the skin by a half or a third—indicating a considerable drain of nervous energy; that an interval of three hours after this study is *insufficient* for recuperation; that afternoon work should take the form of physical exercise, gymnastics, *under supervision and not in large numbers, and especially without the excitement that games induce;* and that half an hour is the maximum of sustained attention of which children from nine to twelve years old are capable. These results are worth noting, especially the qualification in italics, which flatly contradicts English practice. But the most interesting part of the results is to us (alas!) nothing new, although we did not gain our knowledge through the æsthesiometer. Measurements were made on teachers after a spell of class work. Result—"They indicated a state of exhaustion which often made them incapable of continuing usefully their work during the rest of the day, or even of undertaking any other work." Which hardly needed demonstration.

and its Application.

FOR a new and striking "object lesson" commend us to the experiment conducted by Mr. George in New York—a school republic. In this institution rules, means of governance, punishments, and rewards are settled by the scholars, who act like the citizens of a great community. It is a bold experiment; but although it may act as a living object lesson, it fails to appeal to us. But the fact that such an experiment can be made, and continued during a period of nearly ten years, speaks volumes for the general interest taken in educational matters in America, in contradistinction to the difficulty experienced here in making any experiments at all. How many educational authorities in England would, for example, give facilities for experiments in a curriculum on the "concentration" plan, or for systematic experiments on "reformed" methods of language-teaching, to mention nothing else?

Room for the Experimenter, please!

A CURIOUS little note occurs in the *Revue Pedagogique*. A writer in a political review is taken to task for his evident admiration of the American cult of the "almighty dollar." He has been investigating commercial instruction in the United States and its relation to social morality. He finds, in effect, that its result is to cause the cult of money to be professed generally. But instead of being joined to the feeling of avarice, as he declares it would inevitably be in France, this cult is, in America, joined to the notion of *power*. To gain power is held up (we are still quoting) to American youth as a thing good and proper. So that the estimable man is the one who works, on principle, to satisfy his wishes, to gain power. This looks as if the formation of the American millionaire began in the schoolroom. But our contemporary falls foul of the writer for the ease with which he casts overboard the *mediocritas aurea*, and, as it wittily puts it, crosses the Atlantic. It used to be said, "To make a senior wrangler, catch him *young*." In America the same apparently holds good of millionaires.

Where Millionaires are made.

N.U.T. NOTES.

IN a variety of ways the Benevolent and Orphan Fund is intimately connected, by rule, with the N.U.T. Thus: The general secretary of the National Union of Teachers is always the secretary of the fund; twelve members of the Executive have seats on the Central Council; the annual meeting of the subscribers must be held every year in connection with the Conference of the N.U.T.; and every six months the Central Council must report to the Executive on the work and progress of the fund. Until quite recently a purely nominal charge was made by the Executive for what are termed "Office Expenses"—to wit, rent, rates, taxes, heating, lighting, cleaning, insurance, repairs, and the like; but this charge has quite disappeared, and an additional £150, at the very least, is at the disposal of the Council for the relief of the suffering and distressed. The half-yearly report last submitted to the Executive sets out, in great detail, the extension of the benefits granted since Easter by the fund. Annuities paid to women have been increased from £25 to £30, thus placing them on the same scale as men. Home allowances have been raised from 5s. to 7s. 6d. per week, in the case of all children above eleven years of age. What are known as "special grants" to orphans have been increased from 2s. 6d. to 3s. 6d. per week. Last (and most important) of all, an additional election to annuities and home allowances was made by the Council in June last, when 15 annuities and 15 home allowances were granted. The Council estimate that the benefits enumerated above will entail a *permanent* annual charge upon the fund of nearly £1,600—a heavy responsibility indeed. In addition, a large increase has taken place in the number and urgency of the applications for *temporary* assistance; and with regret one observes that "a

The "B. and O." Fund.

considerable proportion of the increase is due to special cases of a serious nature requiring prolonged and special treatment in sanatoria and homes of rest." Altogether, the Council estimate that the expenditure for 1903 which comes under the heading of "Temporary Assistance" will exceed that of the previous year by no less a sum than £1,600. The report concludes with an expression of thanks to the members of the Executive "for their persistent efforts on behalf of the fund when acting as deputations at local association meetings." The annual "Bristol Dinner" on behalf of the fund realized £120, and the intelligence was naturally received "with acclamation" by the Council.

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THE M.B.T.A., at its annual meeting, rejected a proposal to impose an entrance fee on all teachers who had been eligible for membership for a longer period than six months. 'Mongst those who opposed the suggestion was Mr. Marshall Jackman, one of the ablest and most strenuous of the many capable men who have passed the chair of the Union. The *Board Teacher* credits Mr. Jackman with saying: "His experience as an officer of the N.U.T. was that the Union would willingly take off their entrance fee if they could do so, but it would not be fair to the members who had paid it." Mr. Jackman, of course, stated what he honestly thought. Yet I very much doubt whether his conviction at all "squares" with that of the hard-working secretaries and treasurers of the local branches of the N.U.T. Previous to the imposition of the entrance fee, members were accustomed to drop in and out of the ranks in a most perplexing, not to say alarming, fashion. The entrance fee has steadied the Union's membership very materially, and immensely relieved the local officials, to whom the Union owes so much. Considering the great advantages of membership, as well as the vast amount of accumulated funds and prestige, an entrance fee of five shillings appears to me to be trivial indeed. Even this modest crown is not asked from the newly-certificated teachers who join by November 20th of the year in which the certificate examination is passed. Further, a rule of the Union provides that no entrance fee is required in the case of one resuming teaching after having left the profession, if (1) he was a member at the time of leaving the profession, and (2) he rejoins the Union within six months of the time of resuming work in school. On the other hand, teachers who have been members of the Union, and allowed their membership to lapse during any one of the past ten years, are —very properly, in my opinion—required to pay a *double entrance fee* on rejoining. Personally, I am fast coming to the conclusion that it may be necessary, before very long, to introduce an "age limit" for Union membership. My experience at Russell Square, more especially in connection with the work of the B. and O. Council, leads me to believe that not a few men and women exist who, in the prime of their mental and physical activity, deem themselves strong enough to stand aloof and alone, but who, when their powers begin to fail and decay, creep through the "open door" by the payment of the miserable five shillings entrance fee. Individuals such as these I would decline to admit under *any* consideration.

Admission to the Union.

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"IMPERIALISM" has been much in the air during the past few years. Consequently, it is not at all surprising that, from various quarters of the empire, come inquiries to Mr. Yoxall regarding the possibility of affiliating associations of Colonial teachers to the N.U.T. The Organisation Committee of the Executive came to the conclusion that there were but two practical ways of effecting this. The first (and simplest) plan would be to federate these Colonial teachers' organisations as local associations of the Union, this affiliation carrying with it all the ordinary privileges, and the subscription to the N.U.T. to be at the ordinary rate. Obviously there would be some little difficulty in rendering direct help in what are known as "Tenure" cases, though, by means of representations at the Colonial Office, it would doubtless be possible to bring indirect pressure to bear, through the governor of the colony, upon school managers. Legal assistance would, outside the inevitable delay caused by distance and interval of time between vacations, present little more than the usual difficulties. Personal investigations by representatives of the Executive would naturally be impossible. The second method of dealing with the question would be to affiliate an association of Colonial teachers, but not to regard such as a local branch of the Union. Neither should membership of it carry the ordinary rights and privileges, nor involve the ordinary payment. Upon the payment of a minimum annual fee of one guinea, to be increased at the rate of one shilling per member per annum when the membership exceeded twenty-one in number, the Union would supply associations federated in this manner with all information and advice which could be forwarded by letter (though without taking responsibility for legal or tenure assistance), and provide the secretaries of such associations weekly with the organ of the Union, together with copies of annual reports, pamphlets, and circulars as issued to the local associations. The Union might also undertake to make representations, when needed, at the Colonial Office, and by means of questions in Parliament, etc. At its last meeting the Executive agreed to federate the Sierra Leone Teachers' Association, in accordance with the second method; and further, to afford representation at Conference, in a kind of honorary way, to any of its members who might happen to be in England at the time. The teachers of Prince Edward Island, Canada, have just formed an organisation to unite the teachers of the entire province, and it is highly probable that they too will speedily ally themselves with the palladium of the teachers of England and Wales.

"Hands across the Sea."

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THE correspondence columns of the organ of the Union probably convey a fair indication of the subjects nearest the heart of the thoughtful teacher. One wearies occasionally of the reiteration of the woes of, say, the "Third Division;" yet this and cognate questions are of almost vital importance to an appreciable number of our profession. Possibly no subject ventilated of recent years has aroused quite the same degree of interest as that of "Class Teachers in London," which, for a number of weeks, has been filling the columns of the *Schoolmaster*. An anonymous scribe began the fray by criticising the proposals made by the M.B.T.A. to the London School Board, with reference to a new scale of salaries for both head and class teachers. Mingled with many cogent comments were, one regretted to note, various fuliginous references to head

Salaries of Class Teachers.

teachers and their work, which, even if true, could not conceivably advance the cause of the class teacher. Probably no man—in this country, at all events—has addressed more meetings, public and otherwise, on the question of the status and remuneration of the certificated class teacher than myself. I invariably emphasised the fact that the class teachers are the *real teachers*—the men and women whose duty and privilege it is to form and mould the characters of the nation's little ones, to cultivate and develop the children's intellects, and, in a word, to train and equip their charges for life's great battle. Every one knows that in the gargantuan educational establishments allowed to be erected for so many years, the head teachers are constantly employed in examining, organising, syllabusing, etc. They have absolutely no time for *teaching* the children, although educationists recognise that such teaching is the most valuable part of their work. To myself, it savours of a great national loss that so many of the teachers possessing lengthy experience and intimate knowledge of child-life are prevented by the size of their schools from taking a fair share of the noblest of our privileges. This, however, does not justify nameless critics in holding the whole race of head teachers up to contumely and obloquy. I am glad to think that the leaders of the N.F.A.T. were ever constant in their adhesion to the principle of "levelling up" rather than pulling down, and their success has been phenomenal. London is the one place in the kingdom where practically no improvement has taken place in the position of the certificated class teacher since the national movement began. I wonder why!

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The L.S.B. Deputation.

FOR the past few months a feeling of uneasiness has pervaded the hearts and minds of the teachers in the service of the School Board for London, lest, in addition to the usual school inspections by His Majesty's inspectors, there should be introduced a formal annual examination by the Board's own inspectors. A committee of the London Executive members and the officers of the Union met several times, and drafted a remarkably full and complete memorandum on the subject of "Inspection *versus* Examination." Attached to this memorandum was an appendix containing evidence drawn from official sources, confirming the statements made therein. As a matter of fact, many of the strongest utterances against the "bad old system" were quoted from the Board's own reports and official documents, and ought to be doubly convincing. On the last Thursday in November a deputation consisting of Messrs. Marshall Jackman (ex-president N.U.T.), Hamilton (treasurer), J. H. Yoxall, M.P. (secretary), T. T. Barkett, W. P. Folland, W. Hurden, W. A. Nicholls, and myself attended at the Embankment in order to submit the memorandum. Dr. Macnamara, M.P., introduced the deputation, and called on Mr. Yoxall to deal with the prayer of the memorial. Mr. Yoxall's admirably-prepared and succinct address doubtless made a considerable impression on the members of the Board, and my own feeling is that nothing in the nature of systematic formal examination will, for the future, be permitted in the schools. Both Mr. Yoxall and Mr. Jackman came out of a searching catechism with flying colours, and then, on the motion of Dr. Macnamara and Mr. Barnes, the memorandum was referred to the S.M.C. "for consideration and report."

A Valuable Return.

DURING his six or seven years' membership of the Executive, Mr. A. R. Pickles, B.A., chairman of the Education Committee, has prepared a series of extremely valuable reports dealing with the organisation and educational work of the Union. His latest effort has been in the direction of compiling some seven or eight elaborate tables giving particulars respecting salaries and staffing in the education authorities of the county of Lancashire. These should be in the hands of the secretaries of all the local associations; and for speakers at public meetings, for members of deputations seeking improved conditions of service, or for use in the local press, they supply just the facts that are necessary. A. C.

NOTES FROM THE NORTH.

Teachers' Troubles.

THE pernicious habit of bringing teachers to court for the most trifling of reasons is largely on the increase on this side of the Border. The most recent case that has come under my notice is very similar in many respects to others that have preceded. In one of the small villages in the kingdom of Fife, a teacher, who had recently settled there, was much annoyed by boys knocking at the windows of his lodgings after school hours. To one of the boys the teacher one day in school administered corporal punishment for this. As a result he was brought before the court. In giving judgment, the magistrate said it was not for the good of their youth to be allowed to bring a teacher to court on such a frivolous charge. It was even saddening to think that, because a boy got a few "palmies," the career of his teacher might be blighted by his being brought into such a position. He believed in the good old style of punishment. When a boy went home in those days and told that he had been whipped, the whipping was repeated by the parents. He sympathised with the teacher, who, he was sure, had no malicious intent in punishing the boy, and he found him not guilty of the charge. How long is this state of matters to continue? In many rural districts a teacher's position is not an enviable one, and the very fact that he may be professionally ruined is one that is militating very seriously against the present professional outlook.

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The Scottish Cockerton.

A CASE of some importance with regard to the secondary schools of Scotland has just been decided. The School Board of Callander, Perthshire, entrusted the management of their higher class public school to a body of managers, of whom five were members of the School Board, and four were representatives of the adjoining parishes, from which children attended the school, but whose parents, being outside the School Board district, could not be rated for the upkeep of the school. A ratepayer refused to pay his share of the rate applicable to the school, and an action was raised against him in the sheriff court. The objecting ratepayer pleaded (1) that the School Board had exceeded their powers in delegating the management of the school to another body; (2) that the School Board had no power to rate the parish of Callander for the benefit of adjoining parishes; and (3) that they were not entitled to pay for a higher class school out of the rates. The sheriff-substitute decided in favour of the defender, on the ground that School Boards had "no statutory

warrant to have levied for them school rates for the provision of higher education in a higher class school." This decision was a decided blow to Scottish higher class schools. An appeal was, however, lodged against the decision.

* * *

The Decision Reversed.

THE sheriff-principal on appeal has reversed the decision. In his note appended to the decision he says, *inter alia*, "I am not convinced that it is illegal for School Boards to provide secondary education, and to have rates levied for the purpose of doing so. There is nothing in the history of Scottish education, nor, so far as I can find, in the Education Acts, to confine School Boards to providing only elementary education. It is true that the providing of elementary education is the only compulsory duty with which they are charged; but it seems to me, for anything that appears to the contrary in the statutes, it is lawful for School Boards to expend money raised by rates on secondary education; and it is well known that before the days of School Boards many parish schoolmasters carried their most promising pupils far beyond the limits of what is generally known as elementary education. The Cockerton case, accordingly, has no application to Scots education, as, indeed, the sheriff-substitute says, although he has not on that account hesitated to lay down the same law in the present case on a consideration of the Scots education statutes." School Boards in charge of higher education will now breathe more freely. Last year the amount spent from the rates on higher class schools was £26,449. It should be said that the Scottish Education Department advised the Callander School Board to appeal.

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Wider Areas necessary.

THE sheriff-principal, with reference to the question of other parishes sending children to the M'Laren High School, Callander, says:—"I am rather disposed to concur with the view of the School Board, and apparently of the Scotch Education Department, that in the present state of the law there is no suitable machinery for the maintenance and upkeep of a higher class school for a group of parishes or a district of a county. I, therefore, do not think that the School Board have, in this respect, failed in their duty; but I hope that in any future Education Act for Scotland due provision will be made for furthering higher and especially technical education, by forming larger educational areas than parishes, and instituting more effective educational authorities for such purposes than the ordinary Parish School Boards, whose local functions might very well, except in the case of large towns, be merged in the Parish Councils, thus saving considerable expense and trouble to ratepayers and the public." The sheriff-principal has thus materially supported the great desire of teachers for enlarged areas of educational administration.

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S.C.T.'s and Proposed Bill.

THE Scottish Class Teachers have had the proposed Education Bill under discussion, and have come to the following findings on the subject:—

1. *Central Authority.*—That the control of education should be exercised through a Central Authority—namely, a Board of Education responsible to Parliament alone, and acting with the advice of a Council of Education sitting in Edinburgh, on which the teaching profession should be represented.

2. *Local Authority.*—(*a*) That the Local Authority should be directly elected for educational purposes alone, and not by the cumulative vote. (*b*) That the administrative area of the Local Authority should be defined according to the educational circumstances of each locality, but should not be smaller than the "County District" of the Local Government Act, 1889. (*c*) That the Local Authority should prepare, first, a scheme for the organisation of the elementary, secondary, and technical education in its district; and, second, schemes of salary and promotion for the teachers of the district; and should administer these schemes after they have been confirmed by the Central Authority. (*d*) That all moneys now available, or which may become available, for elementary, secondary, or technical education should be vested in the Local Authority.

3. *Teachers.*—(*a*) That the training of teachers should be directed by the Central Authority, along with a Board in each University centre, consisting of representatives of the University, the Local Authorities, and all branches of the teaching profession. (*b*) That the Central Authority should fix the standard of training and qualification for teachers in all schools, and should keep a register of qualified teachers. (*c*) That the appointment and dismissal of teachers should rest with the Local Authority, subject to the veto of the Central Authority.

4. *Superannuation.*—That the Superannuation Act, 1898, be amended to provide (*a*) that the Local Authority contribute annually towards a teacher's pension a sum equal in amount to the "State allowance." (*b*) That all teachers in schools under the control of the Local Authority be included under the benefits of the Act. (*c*) That the contributions by the teachers be fixed at 2½ per cent. of the day school salary, the teacher on retiral being entitled in return to such an annuity as his contributions purchase. (*d*) That in the event of the teacher's decease before the annuity is payable, such teacher not being in receipt of a "disablement allowance," his heirs shall be entitled to the return of his annual contributions in full.

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The Institute and its Examinations.

THE Educational Institute conducts the examinations in connection with the Scottish University Medical Preliminary. Last year some strictures were passed by the General Medical Council with regard to these examinations. It is, however, gratifying to note, from the report of the Education Committee of the Medical Council, that this year the improvements already effected or about to be introduced were so satisfactory that the committee felt justified in anticipating that during the next year the examination would attain in every respect the standard desired by the Council. In future, the examination in Latin and Greek, like that in French and German, will be conducted entirely by means of unprescribed books. Steps have also been taken for the appointment of examiners having experience of the standards and methods of the Scottish University Preliminary and Leaving Certificate Examinations, and these will meet to revise the papers and marks conjointly, before deciding on the passing or

rejection of the candidates. In order to give the committee an opportunity of observing the effects of these and other changes, it was proposed to continue for the year 1904 the recognition hitherto extended to the examination. It was hoped that next year the committee would be in a position to place the examination definitely on the list of those recognized by the Council.

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Inverness Congress.

PREPARATIONS for the E.I.S. Congress to be held in Inverness on 29th and 30th December are now complete. I have been furnished with a programme, and it is evident that nothing will be wanting on the part of the Invernessians to extend a "royal Highland welcome" to visitors to the capital of the Highlands. As was to be expected, the claims and considerations of rural and Highland teachers occupy a prominent position. It is just possible that during recent years too little consideration has been given to these claims. This will be amply atoned for at Inverness. If there is one fault to be mentioned, it is that the programme seems somewhat overcrowded. The surfeit of oratory will, as usual, defeat its own end. Too many subjects are likely to cause too little prominence to be given to the very matters the teachers themselves are desirous of advancing. But perhaps it looks worse on paper than it will in reality be. The social functions are well to the front, and if visitors from the south are not well entertained, it will not be for lack of opportunity. The Congress Committee have been very fortunate in securing the services of Sir Robert Finlay, K.C., M.P., Attorney-General. He has already made a great reputation, and his position in the present Government enables him to be of great service in the cause of education. I trust the first Highland Congress will be an unqualified success. I hope next month to give some account of its proceedings.

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Employment of Children Act, 1903.

THE Employment of Children Act comes into operation on January 1, 1904. The first section authorises School Boards to make by-laws prescribing for all children under fourteen, or for boys and girls separately, and with respect to all occupations, or to any specified occupation (*a*) the ages below which employment is illegal, (*b*) the hours between which employment is illegal, and (*c*) the number of daily and weekly hours beyond which employment is illegal. The second section authorises town councils of burghs exceeding seven thousand inhabitants, and elsewhere county councils, to make by-laws with respect to the practice of street trading by persons under sixteen years of age. The third section imposes general restrictions on the employment of children. Thus (1) a child under fourteen shall not be employed between 9 p.m. and 6 a.m.; but the School Board may vary these hours either generally or for any specified purpose. (2) A child under eleven shall not be employed in street trading. (3) No child under fourteen who is employed half-time under the Factory and Workshop Act, 1901, shall be employed in any other occupation. (4) A child under fourteen shall not be employed to lift, carry, or move anything so heavy as to be likely to cause injury to the child. (5) A child under fourteen shall not be employed in any occupation likely to be injurious to his life, limb, health, or education, regard being had to his physical condition. Under this Act the duties of School Boards in regard to the employment of children are very much extended. The provision which refers to injury to education points to the child's employment out of school hours being of such a kind as to make him too tired for school work. This is a matter to which teachers have frequently called attention, and it is to be hoped that School Boards will give it their most careful consideration in connection with the working of the new Act.

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Edinburgh University and Practical Training of Teachers.

PROFESSOR DARROCH, in his introductory lecture to the class of education in Edinburgh University, referred to the great need that existed in connection with the Education Chair for practical training. The point has been frequently referred to since that time. Sir William Turner, the Principal of the Edinburgh University, in a speech at the Merchant Company's annual dinner, took occasion to request the co-operation of the Merchant Company in carrying out such an idea. The University, he said, could train the youth of the country in the theory of education, but had no means of training them in the practice of it. Training in the practice must be given in the schools; and so he asked the Merchant Company to make some arrangement in their schools to afford the Professor of Education an opportunity of providing practical training for his students. He gave as a very good reason for his request the fact that under the English Education Act all teachers must be registered, and it was a condition of registration that the applicant should have a certificate of having gone through a course both of theoretical and of practical training. In view of the invasion of England by Scottish schoolmasters and mistresses, he desired to see the University of Edinburgh able to give such certificates. It is clear that, though not specifically mentioned, Sir William Turner was dealing principally with teachers in secondary schools.

R. G.

THE PROGRESS OF EDUCATION IN EGYPT.

CONSIDERING the fact that Egypt has now for years been under British administration, and that, moreover, the staff of the Ministry of Public Instruction includes many of our old college friends from Borough Road, Saltley, etc., and the universities, our interest in the progress of education in that country is naturally keen. As is well known, Egypt has been passing through a most serious crisis of bankruptcy and chronic poverty, and is only now approaching what might be termed convalescence. Nothing but the dogged perseverance and courage of Lord Cromer has pulled the country through and overcome the great opposition persistently displayed, regardless of the merits of any proposal, by the Powers, and even by the Egyptians themselves, whom the measures were intended to benefit.

The Ministry of Public Instruction was one of the many sufferers of this national poverty, and only now, when the great engineering feats of barrage and reservoir-making and the construction of canals are accomplished, and the Egyptian Government assured thereby of a regularly increasing income, has the stinted annual Budget allowance been augmented so as to be slightly more adequate to the wants of the Department.

The Government Schools.

Education is not compulsory in Egypt, and neither are there any school rates levied. The Government has now established thirty-three primary schools (twelve at Cairo,

and the others in the most important towns), three secondary schools, a school of medicine, training school for women nurses and midwives, school of law, polytechnic school of engineering, two training colleges for men, one training college for women, school of agriculture, and two technical schools. There are, besides these, two important Mohammedan universities, attached to mosques and attended by Moslems from all parts of the world, the native elementary schools, and the schools of different missions, religions, nationalities, and communities.

Fees are now paid in all Government schools except the training colleges for teachers, and vary from £5 per annum in the primary schools for day pupils to £35 for day pupils of the School of Agriculture. Accommodation is provided in some dozen schools for boarders at an extra charge of £15 per annum, and most schools provide a midday meal for pupils at £3 per annum.

The Primary Schools.

The primary schools most nearly correspond to the elementary schools of England. An admission examination is held in Arabic, penmanship, and arithmetic; and candidates must be between seven and ten years old. The course at the primary school extends over four years, and the syllabus includes—(1) Arabic, (2) English or French, (3) arithmetic, (4) geometry, (5) drawing, (6) penmanship, (7) geography. At the end of the course students may be examined for the "Certificate of Primary Education." This certificate at present qualifies for admission to the Civil Service, and is consequently much valued. The examination calls for a much higher standard of knowledge than that of Standard VII. in our English schools. The Arabic language paper is difficult, and the arithmetic, English grammar, and geography questions are about equal to those of the second certificate of the College of Preceptors. Considering that the pupils answer several papers in a language foreign to their own, this reflects the greatest credit upon them and their teachers. Formerly French was the favourite language, but English has now almost entirely displaced it. The attendance in the Government primary schools in December 1902 was 6,042 (5,785 boys and 257 girls), and 2,345 candidates sat for the Primary Certificate.

The Secondary Schools.

The secondary schools correspond somewhat to our English secondary schools, and the four years' course covers practically the equivalent of the work required for the London Matriculation Examination. Hitherto the secondary schools have not been popular, but the reason was obvious. The possession of the Primary Certificate sufficed for admission to the Civil Service, and little or no pecuniary advantage was offered to those holding the higher certificate. Now, however, for the future, candidates appointed to Government employment with only the Primary Certificate will not be eligible for posts carrying with them a salary of more than £10 per month. In December 1902 the attendance at the secondary schools was 816, and 282 candidates sat for the secondary certificate. Besides providing the Civil Service with a better-qualified applicant, the secondary education gives an excellent groundwork of education to those entering the Medical School, the School of Law, and the Polytechnic School of Engineering, all of which are prospering and doing excellent work. The curriculum of the secondary schools includes English or French, arithmetic, mathematics, geometry, chemistry, physics, drawing, and geography.

The Training Colleges.

That Lord Cromer should year by year lament, in his report, on the want of teachers and the poor attendance at the training colleges, seems amusing in the extreme. It would be unfair to give a list of teachers' salaries, for naturally conditions of living differ in Egypt and in England; but is it to be imagined that the native has no regard for future prospects? Here, then, is the case in a nutshell. A possessor of the Secondary Certificate may enter any of the special schools just mentioned, or the training college for men, and, having passed through his course, emerge as a fully-qualified doctor, lawyer, engineer, or teacher. Is it likely that he will choose of these the profession least respected and worst paid? Granted that the Government has as an incentive offered to admit him to the training college free, the fees in each of the other three special schools are but £15 per annum, and this small amount, to the class of student taking up a profession, is practically inconsiderable. As doctor, lawyer, or qualified engineer, his prospects will be infinitely better than those of a teacher, and his initial salary, though under the same Government service, will in some cases be almost double the teacher's. Behold, then, the result. Fifty-eight per cent. of the teaching staff consists of untrained teachers, whilst thirty-three per cent. of native teachers of English have no professional diplomas! The training college for native teachers of English has but nine students, although admission is free; whilst the college for teachers of Arabic turned out but four qualified teachers last year! The question is wholly one of teachers' salaries.

The Native Elementary Schools.

During the last five years the Ministry of Public Instruction in Egypt has perpetuated to itself a lasting monument of honour, and one which will indeed radically affect the future history of the country, by a twofold work—the raising of the native voluntary schools, and female education.

To describe an average native elementary school would be to picture an almost incredible state of filth, want of light and ventilation, and incompetence. Most of the native schools are attached to some mosque, and school fees are often received in kind. Many have actually no windows, some are below the ground level, and, according to the recent report on these schools, one room was so low-roofed that the master could never stand upright. They were never whitewashed, and the children suffered from ophthalmia and many other complaints occasioned by sitting on the ground and by bad drinking-water. The teachers were often blind, and many were so ignorant that they could do no more than recite by heart parts of the Koran. Added to this there were no sanitary arrangements, and the corners of the rooms or the space immediately outside the exit sometimes served as conveniences, so their condition can be imagined. A code of very elementary rules was therefore drawn up, fixing the syllabus of work to reading, writing, and simple arithmetic in Arabic; necessitating the annual whitewashing and periodic cleansing of the schools; and prescribing a trite code of morals for both teachers and pupils. All native elementary schools submitting to Government inspection and following this code are now allowed annual grants-in-aid, on the average attendance, of 2s. or 3s. per boy, and 4s. or 6s. per girl, according as the school attains a fair or excellent standard. The number of pupils under inspection in native voluntary schools was in 1898 only 7,534, but has now increased to 39,135.

When these schools were first being brought under Government inspection, 98 per cent. of the pupils were suffering from eye diseases; but the effect of cleansing, lighting, and, moreover, the good offices of the Government doctors specially appointed for the schools, has been to reduce this rate to about 68 per cent.

The Government is now providing centre classes for the free training of teachers in these native schools in elementary reading and writing, and the first four rules of arithmetic in Arabic, and simple rules of school management. What the effect of this wise policy will be should be shown at the next census. In 1897, 91·2 per cent. of the male and 99·3 per cent. of the female population were unable to read and write. The policy should certainly have an elevating and civilising effect on the country generally.

Female Education.

But a few years ago the attitude of the Egyptians to the question of female education was not merely indifferent: it was frequently hostile. The remarkable change which has now come over Egyptian public opinion has doubtless been brought about by contact and influence of Europeans, but obviously more especially by the grants-in-aid of female attendance in schools. This grant is double that on the boys'

attendance. Consequently it is not surprising to hear that during the last five years the number of girls in native schools has trebled. It has grown from 1,040 in 1898 to 3,837 in 1902. The two higher primary schools for girls and the training college for female teachers are prospering, and doing excellent work. There is no doubt that the training of native female teachers will have an excellent effect on female education. Two highly-qualified English mistresses are now in charge of the girls' schools.

Technical Education.

That the value of technical education has been recognised in Egypt is shown by the fact that since 1889 nearly 1,000 pupils have passed through the Government technical school, and the demand for those who have completed their course of training is always in excess of the supply. The school has been worked up gradually, changes being made where anything was found to be obviously unsuited to the needs of the country or the pupils; improvements have been carried out, and the school is now in excellent working order. The fee for day boarders is £8 per annum, and there are now 379 pupils under training at the school.

With a view to affording still further encouragement to technical education, the Government has now, at a cost of £15,000, erected a model workshop at Cairo for training artisans. Only such machines have been purchased as an Egyptian workman may, under ordinary circumstances, expect to use in the habitual exercise of his craft after leaving the establishment; and careful instruction is given in mechanical drawing, working from drawings, and practical workshop arithmetic.

The establishment, when in full work, will have five branches, each particularly adapted to the general native trades of the country. One will embrace simple smiths' work—fitting, metal-turning, etc.; a second, metal-plate work; a third, simple leather work, such as saddlery, harness-making, bag-making, shoe-making; a fourth, painting and decorating; and the fifth, carpentry, joinery, and a certain amount of carriage-building. Each branch is to be directed by a British foreman of experience, assisted by two competent Egyptian leading hands. To these are added a few of such ordinary workmen of fair proficiency as are willing to bind themselves to work for four years for a moderate wage in order to benefit by the instruction. To these, again, are added apprentices between twelve and fourteen years of age, bound for three years, at the rate of three to each workman. The accommodation is about four hundred, and on the opening of the school last January seventy-five apprentices and twenty-five workmen were admitted for a first year's course. The school is established on a decidedly practical, original, and profitable basis, and its success should be ensured by valuable results.

A small industrial school, for instruction in carpentry and joinery, has also existed for some years at Mansourah. The fee for day-boarders therein is £5 per annum, and there are now forty pupils in the school.

The example of the Government is now being followed by spontaneous efforts on the part of Egyptians and school authorities to provide technical education. The industrial school established by a French mission, "Les Frères des Ecoles Chrétiennes," at Alexandria, on the lines adopted by the Government, has been extremely successful.

Of other Government special schools the most successful are the School of Agriculture, containing forty-eight pupils (thirty natives and eighteen foreigners, mostly Greek); the School of Law, with ninety-nine students in the French and fifty-nine in the English section; and the School of Medicine, with some fifty students, practically all of whom are instructed in the English language. The School of Medicine is attached to the Government hospital at Cairo. During the outbreak of cholera last summer the students of the fourth and third years were employed as sanitary officers and assistants in the cholera hospitals in various centres of infection, and did most excellent work. The staffs at these schools are highly competent and qualified, and consequently the advantages offered to the students compare favourably with those of the chief English and Continental schools of a similar kind.

Non-Government Schools.

The non-Government schools other than the native elementary are mostly carried on by religious communities, and some receive substantial aid from their Governments. The best include the Ecoles des Frères, the Greek School, the German School, and the Coptic College. A native Mohammedan Benevolent Society has lately spontaneously subscribed £12,000 towards the establishment of a model workshop at Alexandria, whilst the Victoria College has just been instituted on the lines of a British high-class school in the same town by means of subscriptions of residents in Egypt of all nationalities. Many of these foreign schools give excellent teaching; though, the hours in both French and German schools being far too long, the health of the children is unfortunately far below what it should be. No town in the world presents such excellent opportunities for acquiring languages as Cairo. Most parents place their children in two or three schools during their childhood, and thus secure for them, through instruction by foreign teachers, and by contact with children of the various nationalities, a good knowledge of the French, German, Italian, English, and Arabic languages. Most people in Cairo and Alexandria and the other large towns of Egypt can speak three or four languages.

Conclusion.

In conclusion it should be said that the English teaching staff of the Government schools deserve the highest praise for their conscientious, steady work. The native teachers are characteristically obliging and loyal, and the boys extremely anxious and willing to work. The boys are now drilled and trained in sports, and many of them outrival English pupils in football and gymnastic agility. This valuable training greatly conduces to manliness and candour, qualities very desirable in an Arab. The whole of the regulations regarding work and discipline have been most judiciously evolved by the inspector-general and his staff; and whilst every respect is shown to recognised national observances and religion, the policy adopted by those in authority, whether as inspectors or as head-teachers, is impartiality and firmness.

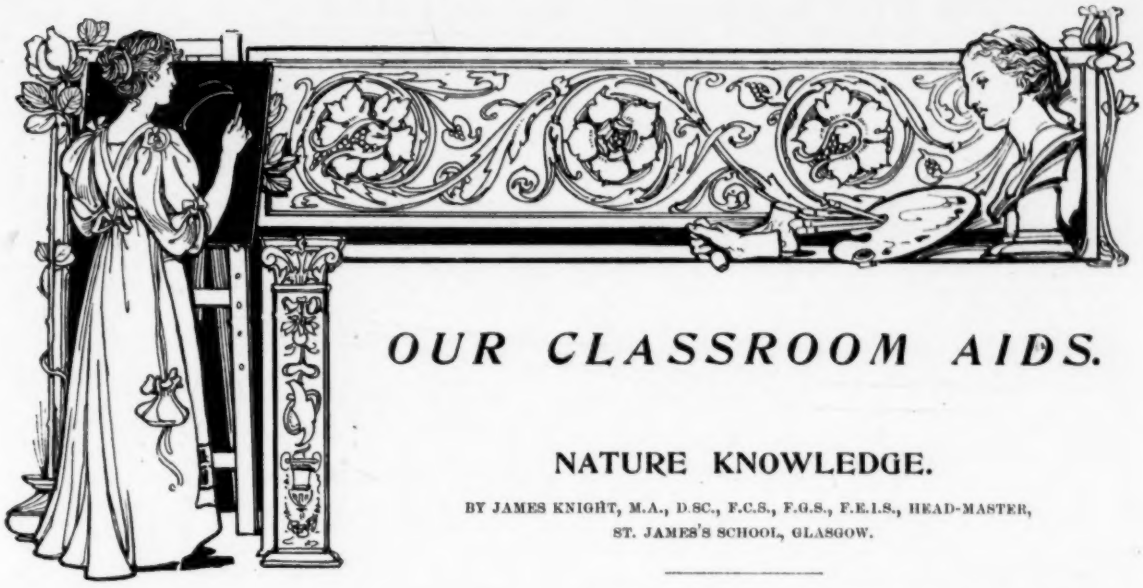
The following table shows at a glance the great progress made of late years:—

	Boys.	*Girls.*	*Total.*
1898.			
In all schools	11,021	1,040	12,061
1902.			
Native schools under inspection	35,298	3,837	39,135
Government primary schools	5,785	257	6,042
Government secondary schools	816	—	816
Special schools and colleges	846	13	859
	42,745	4,107	46,852

"Horace for English Readers" is on the eve of publication by the Oxford University Press, Dean Wickham having translated the poems into prose. In his introduction the dean points out that Horace has found a special home in the hearts of Frenchmen and Englishmen, and it is thought that there is a class who would rather have in plain prose the exact things which Horace said than a distant and questionable imitation of the poetical form in which he said it.

The Pupil Teacher's University Scholarship Committee.—We have just received the eleventh annual report of this committee and offer our hearty congratulations on the success that has attended its work. During the past year no fewer than twenty-two former pupil teachers have been enjoying at Oxford and Cambridge the benefits of the scholarships awarded them, and the successes achieved fully justify the scheme. At Cambridge, Mr. Curzon appeared as twenty-first Wrangler, the highest mathematical honour yet attained by one of the Committee's scholars. Mr. A. M. Smith took a first class in each part of the Natural Sciences Tripos. Of *six* third-year men five took honours degrees, and *one* the ordinary degree. At Oxford, Mr. Clark and Mr. Hurst took first class honours.

Six new scholarships will shortly be awarded, and intending candidates should apply for particulars to Mr. A. H. Baker, B.A., 28 Cautley Avenue, Clapham Common, London, S.W.



OUR CLASSROOM AIDS.

NATURE KNOWLEDGE.

BY JAMES KNIGHT, M.A., D.SC., F.C.S., F.G.S., F.E.I.S., HEAD-MASTER, ST. JAMES'S SCHOOL, GLASGOW.

LESSONS ON FOODS: FATS AND OILS.

THE second great class of food stuffs is that represented by the fats, solid and liquid. In the older text-books, and even yet in examination work, these food stuffs are described in misleading terms. Sometimes they are called "heat-givers," as if all foods were not fuels; sometimes they are described as "oleaginous" foods, on the principle, apparently, that five syllables are more expressive than one. A favourite name for them is "hydrocarbons," but to this there are two objections. In the first place, this term gets confused with carbo hydrates, a really useful name, which comprehends all the starches and sugars. In the second place, fats are not hydrocarbons at all, since they are all composed of carbon, hydrogen, and oxygen. By a "hydrocarbon" is meant a substance composed solely of carbon and hydrogen, and numerous examples are ready to hand in benzine, turpentine, marsh-gas, acetylene, and the whole of the paraffin series. Fondness for technical terms varies inversely with the experience of the teacher, and in this case the simplest terms are also the best; call them plain fats or oils.

There is no distinction between fats and oils: fat is solid oil, oil is liquid fat, and they may be got in all stages of consistence, from the hard, white solid of suet down to a very fluid olive oil. Put a small lump of tallow into a wide test-tube and warm it gently: it melts into a clear or pale yellow liquid, which again solidifies on cooling. Lard is a softer fat, but it gives a similar result. Olive oil very often shows both physical states in coldish weather, a layer of liquid floating on the frozen oil below. There is, however, a chemical as well as a physical difference in the explanation of these differing degrees of consistence, and, roughly speaking, it may be said that fats rich in olein are soft and buttery or even liquid, while those rich in stearin are hard, white solids, the extremes being represented by olive oil and suet. All fats may be melted by heat, and all oils freeze into solid fats.

Many of them have a peculiar taste and smell, very often due to impurities, since they are less pronounced in refined samples (compare samples of commercial and refined castor oil). They are all oily to the touch, and leave on paper a stain which is dark to look at but light to look through.

All fats are lighter than water. This may be shown for a liquid fat like olive oil by gently pouring some oil on to water in a test-tube. A solid fat, such as tallow, may be melted and treated in the same way, but the experiment will be more telling if a bit the size of a marble is boiled with water. As the fat melts it rises to the surface and remains as a pale yellow liquid, which turns solid on cooling. Taking the specific gravity of water as 1,000, all the fats range from 875 to 970, or, keeping to the common fats, up to 912 or so. Their melting-points have wide limits. A handy way of finding the melting-point of a solid fat, such as butter, is to smear the bulb of a thermometer with the fat, then use this to stir some water put on to boil in a glass beaker; note the temperature at which the first particle of the fat melts and floats off, also that when the bulb is quite clear, and take an average.

Float some olive oil on water in a test-tube as before, then shake the contents and allow the tube to stand: in a few minutes the oil will be all at the top, perhaps broken into bubbles, which may be reunited on warming. Repeat this with hot water: same result, showing that oils and fats are insoluble in water. It is useful in removing grease stains to know what will dissolve fats, and they will be found to dissolve readily in ether, chloroform, carbon disulphide, benzine, petroleum ether (except castor oil), and turpentine. To dissolve out fats from any complex mixture chemists use ether and housewives use turpentine, or, better still, benzine. In laundry practice there are three methods of getting rid of fats in the form of stains: first, to dissolve them by means of one or other of these solvents; secondly, to melt them and absorb the liquid by some porous substance, as when the stained fabric is ironed with a hot iron over French chalk or brown paper; thirdly, to remove them chemically, by converting them into soluble soaps—a process to be described presently. They mix freely with each other, as may be seen by adding yellow olive oil to the clear oil obtained by melting suet or lard.

The behaviour of fats and oils on heating is peculiar. Unlike paraffin and other mineral oils, they do not burn at ordinary temperatures, and require a wick when used in lamps. Many books on domestic economy speak of the "boiling-point" of oils and of milk, but there is no such thing. Take, say, two cubic inches or so of tallow, put them into a porcelain basin, heat gently by a spirit-lamp, and observe what happens. First the tallow melts into a pale yellow liquid, then at a temperature about that of boiling water this liquid "crackles," owing to the sudden formation and liberation of steam from the water in the tallow. As the temperature rises the oil darkens in colour, and begins to give off offensive vapours, without showing any visible "boiling." At 315° C. or 600° F. the oil begins to decompose, giving off carbonic acid gas, various volatile organic acids, and hydrocarbons of all kinds, as well as fumes of acrolein, which are very irritating to the eyes. Finally, a mass of black charcoal is left, which may be entirely burnt away at a white heat, leaving no residue at all in the case of a pure fat or oil. These considerations are important in view of the very extensive employment of fats and oils in cookery, either as foods to be cooked or, as in wet frying, the medium

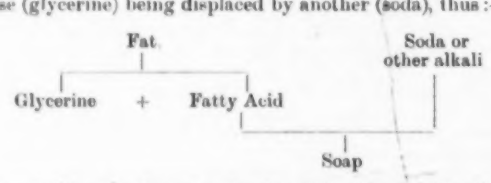
in which the cooking takes place. In our country this medium is almost always lard, dripping, or mutton fat; on the Continent it is almost invariably olive oil. Possibly the prejudice here against olive oil is due to the fact that our samples are generally adulterated with cotton-seed oil, which gives a disagreeable flavour to food cooked in it.

Painters speak of "drying" and "non-drying" oils. Drying oils are those which on exposure to air absorb oxygen and thicken into a superficial crust or varnish. Examples of these are found in linseed, hempseed, and walnut oils. Non-drying oils, if pure, remain unchanged on exposure to air; more commonly, however, they contain small impurities, which invite putrefactive bacteria, and so they become *rancid*—that is, they change their colour and consistence, become acrid, with a disagreeable taste and acid reaction, reddening blue litmus paper. Butter is a good example of this, and most food fats behave in the same way. Very often rancidity may be removed by shaking the fat or oil well with hot water, to kill the bacteria and dissolve out the fatty acids, and by adding when cold a dilute solution of carbonate of soda, to remove the products of decomposition.

Fats are easily obtained from either animal or vegetable sources. Pure lard is simply the natural deposit of fat round the kidneys of a pig, and, like suet, is removed by the knife simply. In other cases the tissues are warmed and the fluid oil drained off, as in the case of keg-lard, tallow, etc.; while in cod-liver oil the livers are allowed to become slightly putrid, when the oil is drained off under gentle pressure. Vegetable oils are obtained, generally from seeds, by crushing them between hot rollers; the term "cold-drawn," as applied to castor and similar oils, implies the use of pressure alone, thus securing only the finer portions of oil. To extract oil from bones or similar hard substances, the materials are first crushed and then digested in a closed vessel along with some suitable solvent such as ether or benzine. The same process is applied to milk. Some milk is poured on a weighed strip of ribbon or blotting-paper, which is then submitted for an hour or two to the continuous action of sulphuric ether. For class purposes milk may be deprived of its fat very easily in a few minutes. Take a tablespoonful of cow's milk in a glass flask, add a drop or so of potash to make it just alkaline and no more, then add three table-spoonfuls of sulphuric ether, close with an india-rubber stopper, and shake vigorously from time to time. After a quarter of an hour the ethereal solution of milk fat will be found floating on the top, and it may be siphoned or decanted off, when the ether may be evaporated, leaving the fat. In using such volatile solvents as ether and carbon disulphide, and to a less extent with chloroform and benzine, care should be taken not to allow the approach of a naked flame, as the vapours of these substances are very inflammable.

Although fats are not affected by either cold or hot water, when treated with high-pressure steam in a closed vessel they are split up into fatty acids and glycerine, each of which may be recovered separately. This is the key to soap-making and also to the digestion of fats within the body.

Take some olive oil in a test-tube, and add about the same bulk of caustic soda solution; now shake thoroughly, and the two clear liquids combine to form an opaque white cream—in short, soap. To separate this soap from the water employed in the soda solution, add a pinch of salt. Since soap does not dissolve readily in salt water, the white creamy mass will separate very thoroughly, and finally harden at the surface to a firm cake of soap, leaving below it a mixture of glycerine and water. The action is one of displacement, one base (glycerine) being displaced by another (soda), thus:—



Repeat this experiment, using the following combinations: 1, olive oil and potash; 2, olive oil and ammonia; 3, olive oil and lime water. Linseed oil may be used instead of olive oil. Observe that the soda soaps are firmer than the potash soaps, the latter being soft and buttery, while the ammonia soaps never set at all into the solid state. The oil-lime combination gives the usual creamy emulsion, a well-known dressing for burns and scalds under the name of "Carron oil." It is really a lime soap; but since it is insoluble in water, this soap is useless for washing purposes. Lastly, make three soaps as above from the combinations suet-soda, tallow-soda, oil-soda, and compare results. It appears that the firmer fats, such as suet and tallow, give firmer soaps; while the softer and liquid fats yield softer soaps, even with soda. In general we may say that soda gives hard soaps, potash soft soaps, since in soapmaking tallow and similar cheap fats are the only ones used.

OUR ILLUSTRATED GEOGRAPHICAL NOTEBOOK.

GERMAN EAST AFRICA.

IT was not until the early eighties that Germany evinced a desire for the possession of territories outside the Fatherland. Her own internal affairs had hitherto absorbed all her best energies, and even in the scramble for Africa she appeared upon the scene long after most of the desirable portions had been marked out by other European nations. Though she seriously entered the competition for African territory, she has been completely outpaced by Britain and France: for since 1884 the former secured 2,800,000 square miles; France, 1,800,000; while Germany's share does not exceed 935,000 square miles. Within the same period Germany has also brought under her influence 9,600 square miles of islands in the Pacific.

In this connection it will be of interest to compare the total land areas of the four great Powers.

Country.	Area—Home Country.	Area—Foreign Possessions.	Total area square miles.
United Kingdom.....	121,000	12,500,000	12,621,000
France.....	204,000	3,740,000	3,944,000
Germany.....	211,000	1,027,000	1,236,000
Russia.....	8,660,000	94,000	8,754,000

Twenty years having elapsed, it is possible to somewhat correctly appraise the present value and prospective capabilities of the German colonies. A recent publication issued by the Scientific and Technical Department of the Imperial Institute, describing the economic development of German East Africa, supplies a mass of interesting matter that has not yet found its way into geographical text-books.

General Description.—The protectorate of German East Africa possesses a coast-line of about 620 miles; and its land boundaries touch British East Africa on the north, Congo Free State, Rhodesia, and British Central Africa on the west, and Portuguese East Africa on the south. The country consists chiefly of vast grassy undulating plateaux, together with a narrow strip of maritime lowland, which only extends a little to the west in the cases of the valleys of the Rovuma, Rufiji, and Pangani rivers. That the land has considerable altitude is borne out by its starting on their downward course two rivers each over two thousand miles in length; for waters passing into the Victoria Nyanza reach the Mediterranean Sea by way of the Nile, and other waters draining into Tanganyika fall into the Atlantic Ocean *vid* the Congo.

Minerals.—The mineral wealth of the protectorate is undoubtedly considerable, and coal, iron, lead, copper, mica, and salt will eventually be worked at a profit. Gold is known to exist, and garnets have been found in large quantities. There are mining regulations in force throughout the colony, but the difficulties of transport are at present practically unconquerable, and mining enterprise in consequence makes but little headway.

Agriculture.—For very many years the economic development of the colony will be bound up entirely in the pursuit of agriculture and stock-raising. The Germans bring much

scientific acumen to bear upon the matter, as shown in the provision of agricultural experimental stations in selected regions. The natives are very inadequately equipped with agricultural implements. In clearing bush-land fire is largely resorted to, and even in the cornfields charred stumps and roots are left for years. Soil cleared by burning is fertile for a year or two, and when it is exhausted the natives, who possess no knowledge of manuring, move to another region to exhaust it in due course.

The following rather desultory notes on the principal crops will be useful in outlining the agricultural prospects of European planters, not only in German territory, but in other African regions of similar character:—

Maize does well, especially in the richer loam soils. There is no definite seedtime, and it can be sown any time during the "three little rainy seasons" (March, July, and December), but the "great rainy season" (May) proves unsuitable. In several regions maize is already the staple food of the people.

Bananas.—Exhausted cornfields are usually planted with them. At present eleven varieties are cultivated, but the supply is only sufficient for local consumption. The fruit is eaten raw or cooked, and in large areas it is an important food. When made into meal it keeps only for about five months.

Cocoanuts are grown chiefly on the coast lands, especially from Rafiji to Kilwa. This district produces more than half the total copra export of the country. European planters grow fibre plants in the cocoanut plantations. A well-kept native holding containing a hundred palms will provide a family with food. The production of copra is increasing, and the native waste in making palm wine is being checked.

Manioc.—There are cultivated four varieties of the plant which yields the crude flour known in Western countries as cassava, and the purified flour tapioca. In regions that are periodically devastated by locusts the natives are being induced to extend the cultivation of the manioc, as its edible roots, being underground, are proof against attack.

Coffee.—The cultivation of coffee is receiving the most careful attention, and the experimental stations have been of great service. Special care is necessary in the selection of sites, for in earlier years the coffee-leaf disease played havoc in the young plantations. Tanga and the adjacent districts seem specially suitable for coffee cultivation, where the Arabian and American varieties have succeeded admirably.

Rice is largely cultivated in the neighbourhood of Tanga, in the low-lying lands that are submerged during the rainy seasons. It is necessary to sow during the first "little rainy season," that the stalks may reach the surface of the water in the time of heavier rains. There are already large numbers of Indian coolies engaged in the rice-fields, and the planters hope that the natives of the coast regions will adopt rice as their staple food.

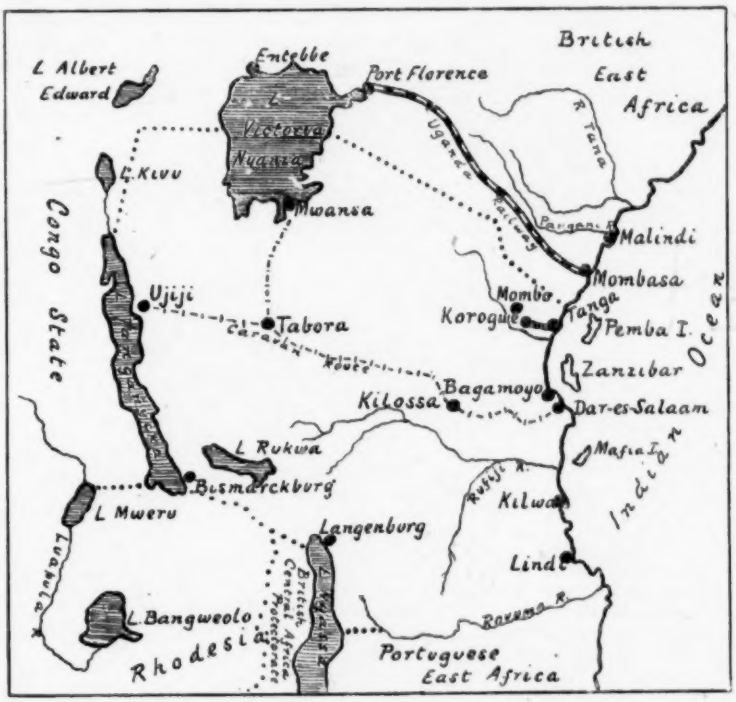
Rubber.—There are numerous native plants that yield caoutchouc of good quality; but the natives have no idea of conserving this source of profit, and strict measures have been necessary against the destruction of rubber-producing forests by fire. Rubber plantations have been established, and the one at Kilwa already gives abundant promise. There is a difficulty in obtaining labour, for the natives for a great part of the year are engaged in the bush, collecting rubber for themselves.

Matama, a variety of the Indian millet and the Egyptian durra, is an important crop in many regions—so much so that the failure of the crop entails much suffering on the natives. A few years ago, in Tanga province alone, famine, caused by drought and locusts, reduced the population by one-half.

Sugar, cotton, tobacco, hemp, and *sesame seed* are also cultivated with success.

Miscellaneous.—Some of the native tribes, such as the Masai, have required very careful management; and drought, locusts, famine, Texas fever, tsetse fly, and coffee-leaf disease have tested the patience of the European settlers. The natives generally are exceedingly indolent. They grow only sufficient food for their immediate wants, make no provision for the future, and do not realise the value of money as a means of obtaining food. The abolition of slavery and the constant decrease in the supply of ivory have given impetus to cattle-breeding in the interior, which is less subject to Texas fever than the low-lying coast lands. There are vast areas, too, where the tsetse fly is unknown. Only one per cent. of the land in Tanga province is cultivated; yet last year rice alone to the value of 400,000 rupees was imported from India.

Wild animals still abound, especially in the west, though in Kilossa last year hunters were paid rewards for killing 11 lions and 122 leopards. Panthers and leopards are very numerous, but elephants are scarce except in the more remote regions.



The lack of railways is the most serious check to progress. There is no railway in the colony except the fifty-four miles of line from Tanga to Korogwe, now being extended to Mombo. The caravan route from the coast to Ujiji is the suggested route for a railway that would do much to open up the country.

The population of German East Africa in 1901 consisted of 6,000,000 African natives, 3,400 Hindus, 2,600 Arabs, 2,000 German troops and police, 995 German residents, and 63 English.

The coast towns are naturally more under European influence than the towns of the interior or the west. *Tanga*, the capital, is not only the first stopping-place for Europeans arriving in German East Africa, but it is the terminus of the only railway and the chief centre for the exportation of coffee. Yet it is a matter of the greatest difficulty to keep a sufficient native labouring population in the town and province. *Bagamoyo* has suffered considerably by the diversion of trade to the Uganda Railway. *Tabora*, though so far removed from the chief centres of European influence, is

particularly flourishing. Here the Arab element is strong, and the whole region shows smiling cornfields as far as the eye can reach. Wheat cultivation is carried on exclusively by the Arabs, who use wheaten bread at every meal. Bees, too, are kept in every village. Gold reefs have recently been discovered near Tabora; which may have an important bearing on the opening up of the whole region within the next few years.

HOW TO MOUNT BIRDS FOR THE SCHOOL MUSEUM.

(Continued.)

Making up the Head.—The head, in its present state, requires a great deal of attention before it looks anything like the real live article. Owing to the absence of flesh and muscle, it has a pinched, drawn appearance, which must be corrected by means of damp clay or putty, introduced little by little through the openings of the eyes. First of all tuck a little cotton wool loosely into the cheeks, to replace cheek muscles and to give contour to the face.

With a needle insert small pieces of clay into the eyes, working them toward the top of the skull, where there is a prominent brow, caused by the bulging eyeball beneath.

At the rear of the eye the skin lies directly on the skull, without any intervening pad of flesh; so do not pack in clay where it is not needed.

The artificial eyes should be round and clear, and of such a size as to go through the lids without unduly stretching them. Holding an eye with the thumb and forefinger, force the wire stalk through the orbit, and well into the clay. Very likely the lids will be forced in as well; if so, take a needle and work round the eye, freeing them little by little, until they lie outside in their natural position.

The shape of the head, the angle of the eye, and the position of the eyelids, all combine to give an expression to the bird; and in order to get this expression right, the beginner must study the particular bird when it is alive. Compare the parrot with the hawk, for instance. How is it that the hawk looks so fierce, whilst the parrot, which has quite as formidable a bill, looks comparatively mild? The hawk has deep-sunk eyes and a beetling brow, totally different from the flat face of the parrot. All these little details must be studied, and the bird-mounter must be prepared to spend a great deal of time before he becomes proficient.

Birds vary so much that it is useless to give any fixed rule, and impossible to go into every little detail. Study the live bird and model the head by means of the clay inside the skin.

The widest part of the head lies towards the rear, across the "brainbox," and from here to the base of the beak it roughly tapers, allowing the eyes, which project *slightly*, to see freely towards the front. When you consider the head finished, point the beak towards you, and notice if the two eyes are in unison; also ask yourself the question, "Could the bird possibly see me?" If the answer is in the negative, thrust a needle into the clay, tilt the eyes up and forward, and rearrange the lids until all is satisfactory.

Making up the Artificial Body.—Four pieces of wire are now required—a medium piece for the body, two stouter ones for legs, and a finer one for the tail. Point these at both ends with a file.

Take the body wire—which must be at least four inches longer than the combined length of body and neck—and, beginning about one inch from the end, wrap tightly round with tow, making the artificial body about one-fifth as wide as it is long, the length, of course, being that of the natural body, which we previously measured. Turn up the protruding inch of wire, thrust it through the body, finally binding all tightly with stout thread.

In making the neck, which must be thin rather than thick, lay the strands of tow lengthwise, and bind extra tightly. When all is finished, bend the body slightly, with the projecting wire A inside. (See Diagram 3.) Open the skin and tie the wings together by means of a needle and thread passed between the radius and ulna, the distance between the wings being the same as in nature. Remember that the

Diagram 3.

wings lie very near to each other. If they are tied too far apart, two unsightly trenches will appear in the back feathers.

Wiring the Bird.—Take the body, and work the neck wire up the skin and right through the skull until further progress is checked by the neck running against the base of the head. A common fault is to put the wire in too far forward, so that the bird's neck apparently springs from its palate. Thrust the wire in at the precise spot where the real neck joined, at the back where the brains were extracted.

Lay the bird on its back, and holding the head so that the beak points upwards, away from the table turn the artificial body (keep the head and neck still) in the skin, until the clenched wire (A, Diagram 3) also faces upwards. Keep the bird in this position, bend the projecting head wire forward

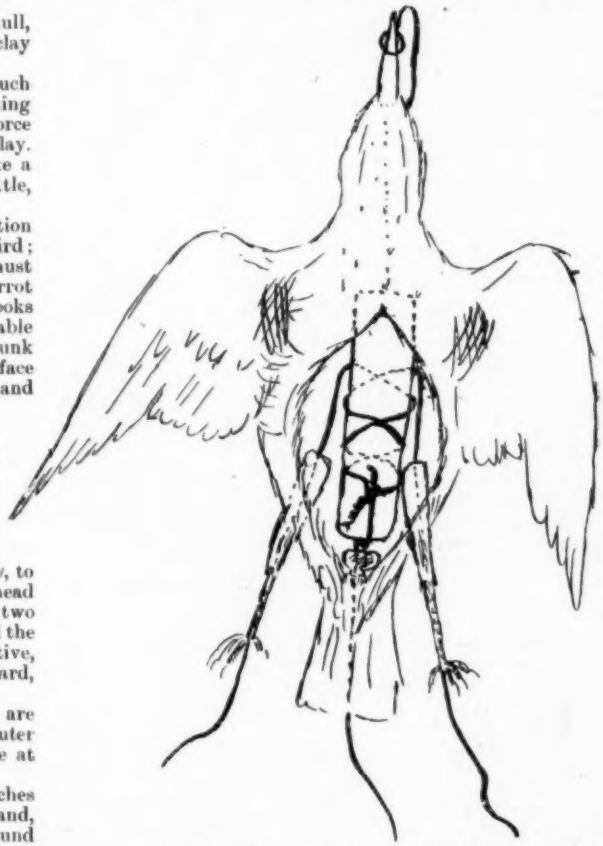


Diagram 4.—Viewed from the Under Side.

and over upon itself, and twist it once round the beak. Wire A marks the stomach, and in all future operations must be kept facing the operator.

Take a leg wire and thrust it through the sole of the foot and up the back of the leg until the joint is reached. Here the point of the wire has a great tendency to burst through the skin, but it must be firmly repressed. With the finger

and thumb hold the leg at the joint, so that it is in a line with the artificial thigh inside; nip the wire near the sole with the forceps, and force it in with a wriggling motion. Any attempt at hurry will result in sudden disaster. When the joint

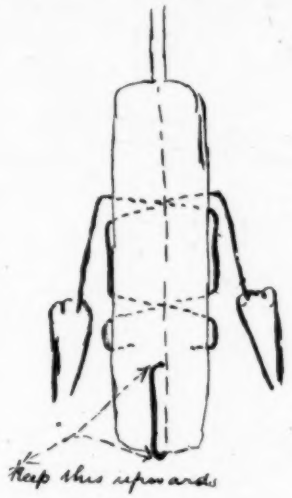


Diagram 5.

has been successfully negotiated, turn the leg inside out as in skinning, and thrust the wire through the artificial thigh until it projects at the end. Push it through the side of the body at right angles, about two-thirds up from the tail end, and (in the case of the starling) pull about three inches through, shifting the thigh down the wire every time it runs up to the body. Twist the free end round the body toward the tail with an overhand motion, and bend the leg parallel.

Treat the other leg in the same manner, bending the wire so that it meets the other wire near the tail, when the two can be twisted together tightly, and turned into the body.

The fixing of the legs is very important. If the wires are not wound tightly round the body and twisted together firmly, the finished specimen will be very "wobbly" and difficult to work with. Diagram 4 will perhaps explain any difficult point, and Diagram 5 gives an alternate method of wiring.

Push a thin wire through the fleshy base of the tail into the body in a slanting direction. When it appears, make a hook at the end with the tweezers, and pull tight. (See Diagram 6.)

Filling in.—What I have called the "body" should really

Diagram 6.—Internal Structure.

be called the "backbone," the true body consisting of loose cut tow, which we will now proceed to pack.

Whole tow *can* be used; but if the beginner is curious enough to try it, he must not grumble at subsequent results. First fill up along the sides of the backbone, especially in the neighbourhood of the leg-wires, and place a small piece of naphaline (albo-carbon) in the bend, for the benefit of certain destructive moths and beetles. One of the latter, known to naturalists by the quaint name of *Dermestes lardarius*, is a perfect fiend, who will take a great interest in your bird if you omit the albo-carbon.

Continue to pack in tow (loosely) until the bird reaches its natural size. Pull the cut edges of the skin into position, and sew up, beginning at the breast, with stitches about a third of an inch apart, and finishing in the fleshy tail base.

Adjusting and Finishing.—To adjust the legs, pull them forward a little, and bend at the joint in their natural position. If they appear too long, push them toward the body before bending. Presuming the operator has a T-shaped perch handy, bore two holes about an inch and a quarter apart (this distance, of course, varies with the size of the bird), and push the leg wires through until the soles of the feet are flat on the perch. Wind the ends of the wire round firmly. The bird is now fixed, and it probably looks a very queer object indeed, with its neck stretched out straight and its feathers all awry.

Except on special occasions, the neck is carried in an S-shaped curve, which accounts for its apparent shortness. This curve we must endeavour to copy, aided by Diagram 6. First bend the neck forward and downward, near its junction with the body. Now bring it gradually upward,

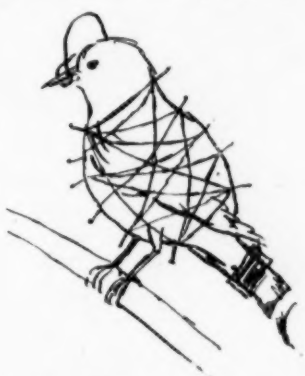


Diagram 7.—Ready for Drying.

and finally tilt the head. This bending business is rather difficult to explain, so please look carefully at the diagram.

Apparently we have made the interior right, at the expense of the exterior.

Take the ever-useful needle and shift the skin about round the neck, lifting at the front and tucking in round the nape. If it does not come quite right at the base, leave it, and get on with the body.

Look well at the body, and note its shape. It is most likely too thin in the region of the stomach, and too tight round the chest. Thrust a needle through the skin into the chest, and gently lever a little of the surplus tow downwards toward the abdomen, in the same manner correcting any other thin places. Another way to raise flat places is to lift up the underlying tow in such a manner that the skin above is also raised.

Now give attention to the back. Between the wings is a broad band of feathers, bordered on each side by parallel bare spaces, which, if the wings are in proper position, are hidden by the overlapping middle feathers. Should the wings be tied too far apart, the bare skin is extended, so that the middle feather-tract is unable to overlap properly, causing two unsightly grooves to appear. Lift each wing upward, so that they lie more on the top of the body, nearer to each other, and fix them in this position by means of long pins thrust through and into the body. The grooves should now disappear.

Take two pieces of thin card, and after arranging the tail

feathers, place one piece above and another below, pinning the two together so as to "sandwich" the feathers flat. The feathers at the base of the neck are sometimes difficult to deal with, but they can usually be put right by lifting the skin at the troublesome points, until they overlap and form a continuous surface.

When the plumage is nicely arranged, look at the specimen from different points of view, to see whether the balance is correct; a badly-balanced bird always gives one the impression that it is about to fall over in a certain direction.

As the skin gets dry, some of the feathers have a tendency to rise and spoil the general outline. To counteract this, the bird has to be "bound" with cotton. Thrust half a dozen long pins into the breast, so as to form a row of projections down the centre, and do the same to the back. Take a reel of cotton, and fasten the end by means of a loop to one of the breast pins. Now bring the cotton up to a back pin, twist it round, and proceed again to the next breast pin.

Connect every pin with thread until the body is covered, above and below, with a network, which, by gently pressing on the feathers, keeps them in position as they dry. Cover the bird up, and put it away in a dry place for a month. At the end of this time take off all the drying tackle, cut away the projecting wires, and the bird is finished.

In the eyes of the novice the first bird is perfection. Cherish it carefully until you have mounted a dozen more, and by this time the eye will have become educated to such an extent that you will consign your beautiful first specimen to the nearest fire.

Practise constantly with common cage-birds, which you can study at leisure in any bird-dealer's window. In the East End, threepence per hatful is the current price for dead birds, providing the dealer is friendly.

In conclusion, if you wish to be more than a mere "stuffer," *study the live* bird, and take an interest in all its doings.

NOTES OF LESSON ON ROAD-MAKING.

The Class.—This lesson is intended for the upper standards of an urban school.

Time.—The lesson would take an hour, but several topics would be touched on during the lesson which could very profitably be followed up in greater detail in subsequent lessons.

Aims of the Lesson.—1. To help the children to take an intelligent interest in everyday operations of life. 2. By exciting their natural curiosity to lead them to investigate the works of nature around them.

I. **Preparation.**—If, as is generally the case at this time of year, a road is under repair in the vicinity of the school, the children should be advised to watch the operation, and to make what observations they can for themselves.

The result of these observations should either form the subject of a composition exercise, or should be elicited by judicious questions. Probably most of the points observed by the children will be insignificant details or accidental circumstances that are useless for illustrating broad principles, and in sifting the wheat from the chaff great tact is required, in order that the children may not be discouraged.

By selecting and arranging the facts the teacher probably finds that the children are familiar with the following points:—

1. *The Shape of the Road.*—The road is left with a rounded surface, in order that the water may drain off to each side and run away along the gutter.

2. *State of the Road before it was mended.*—The road is worn into hollow places, which are filled with water or mud after a shower of rain. Along the side of each road is generally an accumulation of sandy grit, which has been washed there by the rain.

3. *Time when the Roads are best made up.*—The end of winter.

4. *Materials used for making the Road.*—Flints or granite, with sand to fill the crevices.

II. **Presentation.**—Having arranged the knowledge that the children already possess, kindred facts can be added, and at the same time these facts can be compared or contrasted with others, thus fixing the facts and at the same time widening the mental outlook of the child. This forms the third step—**Association.**

Presentation.	Association.
1. Draw attention to the result of the roundness of the road—the water runs off in two directions, according to the slope on which it falls.	Compare the crest of the road to a watershed. Point out that a watershed is not necessarily a range of mountains, for a very gradual undulation will serve to separate the streams flowing in different directions just as effectually as the gentle curve of the road does.
Note the manner in which the water runs off. The tiny streams trickle down, and gradually join together until a good sized stream is formed at each edge of the road.	The drainage of a country is almost identical with the drainage of the road. The brooks join to form streams and rivulets, which in turn become tributaries of larger streams and rivers.
2. Examine carefully some of the sandy grit from the roadside. It consists of fine particles of stone, which have been broken off by the horses' hoofs or the wheels of vehicles.	Compare the formation of seashore and river sand by the disintegration of rocks and boulders.
The formation of this sand indicates loss of material to the road itself; but note that the road does not wear all over alike. The softer spots wear away much more quickly than the rest, thus forming the hollows, whilst the harder parts stand up like little hills.	Indicate briefly how this same process of denudation is in a large measure responsible for many of the prominent features on the landscape. This should be more fully dealt with later on, when the weather is suitable for an outdoor ramble, but a rough section of some prominent physical feature in the neighbourhood will serve to awaken the children's interest on this point.
3. The roads are generally made up about this time, because the frost of winter loosens the ground, thus rendering it more liable to wear away rapidly, and also because new material is more easily rolled in while the road is in this loose state.	If possible, burst a small iron flask by filling it with water, then firmly sealing it and freezing the water. If this is not convenient, compare with the bursting of the water-pipes during frosty weather, and thus lead the children to understand the importance of frost as a denuding agent. Show a picture of a fissure in a cliff caused by frost.
4. *Flints.*—Show that flint is harder than glass by scratching a piece of glass.	Compare the hardness of flint and steel. Show picture of flint weapons.
Ascertain whether any of the children have examined the flints carefully enough to discover traces of chalk on the outside. If not, point this out.	If there are any chalk pits in the neighbourhood, the children can see for themselves the flints embedded in layers in the chalk.
Break two or three flints, and show that they frequently have a grayish centre. This is really a sponge, which served as a nucleus for the flint to form around.	The presence of the sponge indicates that the flint was formed under water. If the school is situated in a chalk district, this point should be followed up.
Sand.—Compare the sand used for road-making (which is probably river sand) with the grit washed to the roadside by the rain. When examined under the microscope, the latter is seen to be angular, while the former is rounded, the sharp points having been knocked off by constant rubbing together.	Compare the sand grains to pebbles, which have been formed and rounded in the same way.

IV. **Formulation.**—The various points of the lesson should be written on the blackboard.

1. The road serves as an illustration for—
   (*a*) A river basin, each side of the road having its own system of drainage.
   (*b*) A watershed, the crest of the road separating one basin from another.
   (*c*) A river and its tributaries.
2. It also serves to illustrate the effects of weathering on rocks and stones, and the formation of scenery by denudation.
3. Materials used.
   (*a*) Flint, black, brittle, very hard stone found in layers in chalk beds.
   (*b*) Sand, tiny particles broken off from stones or rocks.

V. **Application.**—1. Apply the principle of drainage to the build of various countries, and show that in mountainous countries the rivers are rapid, but that in flat countries they are wide and sluggish, and frequently expand into lakes, as in the case of the Shannon.

2. Show the economic value of frost in loosening the soil for the farmer.

3. Point out the necessity of taking measures to prevent the bursting of water-pipes, etc., during frosty weather.

"THE TEACHING OF ENGLISH IN THE ELEMENTARY AND THE SECONDARY SCHOOL." *

THE omens of the title-page of this book are not promising. An American book on the teaching of English, written by a triumvirate, and this a triumvirate of college professors, gives anticipations of peculiarities of spelling, of lack of unity, and of a surfeit of theory unleavened by the sympathy which arises from the hard dynamics of experience. We may say at once that these forebodings are not realised. The spelling is our own English, the three authors have welded themselves into a fair homogeneity, and the book is instinct with sympathy for the difficulties and trials encountered both by teachers and by scholars.

The subject is discussed in three sections, of which the first deals with the claims of the home speech for greater consideration, and the second and third take up the methods of teaching English in primary and secondary schools respectively.

In discussing the value of the home tongue in education, the authors state that mastery of a language consists in (1) the ability of the individual to understand the thoughts of others, whether spoken or written; (2) his ability to express his own thoughts through spoken or written words; (3) his ability to gain æsthetic pleasure through his native literature. So far as they go, these three sum up well the objects we should have in view in teaching our mother tongue; a fourth, "ability to *give* this æsthetic pleasure," hardly falling within the possibilities of a school course.

In tracing the development of the teaching of the vernacular, the authors naturally turn to the Continental systems; and that of Germany meets with great praise, although such praise is given with discrimination. The efforts of our own grammar schools, hide-bound in worship of the classics, meet with severe treatment; but we do not think the authors have inquired sufficiently into the excellent English teaching which is given in our more modern public and higher-grade schools. Unwise, too, we consider the ridicule which the authors cast on the questions set by the examiners for the Oxford Locals in 1900. We do not at all agree with their strictures upon these questions, which we find follow fairly well the lines set down by their own Yale authorities, and do not see what good purpose can possibly be served by such attacks upon professors who are as anxious as themselves to advance the study of English. Our own educational lights of the past—King Alfred, Mulcaster, Ascham, and Locke—are quoted only to make deeper the gloom in which we at present dwell, and the teaching of English in England is dismissed contemptuously as unworthy of notice.

The relative merits of Latin and English are next compared, and a painstaking and impartial statement of the arguments on both sides places the judgment in favour of English. We do not think that the authors have laid quite enough stress upon the points that in studying Latin the pupil spends so much time in studying words and rules that he has no time to grasp the thoughts they convey, and that some years' study of Latin is necessary before he has acquired the ability to use these words and rules—an ability with which his mother tongue much more readily endows him.

The section on English in Elementary Education is the one which readers of this journal will study with most interest. The same difficulties which beset us here do not seem to have been entirely removed from the land of the Stars and Stripes, and the following paragraphs read strangely like some of our own plaints:—

"In many states the schools are poorly equipped and worse taught. Many teachers have not even a good high school education. Their pay is not above that of the day labourer. Their position commands no respect in the community. Professional training, though rapidly increasing, is yet far from general, and in many communities is seldom heard of."

"There are still many teachers who are almost what might be called illiterate."

"He [the teacher] frequently works under the burden of too many hours, too large a class, too few books; in rooms ill-lighted, ill-ventilated, or resounding with the noises in the street."

A little more introspection of this kind would probably have spared our English system the girds which are the only serious disfigurements in an otherwise sympathetic book.

In discussing the various branches of English which are taught in the elementary school, the *principles* and *objects* of such teaching are excellently expressed. No teacher can rise from the reading of this book without feeling a greater enthusiasm for this valuable subject. The dangers of yielding to the fad of "correlation," which is one of our latest *ignes fatui*, are plainly pointed out, and the limits of the usefulness of a principle which all good teachers adopted long before its recent "re-discovery" are well laid down. The *methods* of carrying out these principles, and of obtaining these results, receive too little explanation, and advice is given which seems somewhat out of date even to an English elementary teacher. Thus the authors dispose of the subject of handwriting in a little less than two pages, can find no good in simultaneous reading, do not mention silent reading or note-taking, and praise dictation and transcription as two of the best means of teaching English. Surely the authors are enveloped in the clouds of Olympus or of the Katskylls. Much more wisely, however, the authors claim for formal grammar and for paraphrasing a fair share of attention; and if the amount of space given to the teaching of oral expression seems somewhat too great, it must be remembered that in the United States much value is laid upon such recitals, and that in England we have until lately been behind in this matter.

The discussion of the subject throughout the section shows that the authors have borne in mind the gradual climb upwards from primary, through secondary, to the university courses, and that the division between these various grades of schools is a division of merit and advancement in education only, not, as to a large extent in England, a demarcation due merely to differences in wealth and position.

The whole chapter would be rendered much more intelligible to the English reader if some comparison were shown between the American *grade* and the English *standard*.

The section of the book which deals with English in the secondary school is somewhat lessened in value to us from the fact that the whole course of instruction in these schools has been determined by the adoption of a number of special books as subjects of study for the examination leading to the university course. The choice of these books is due to a committee of ten which sat in 1894, and among the selected books are *Ivanhoe*; *Silas Marner*; *The Last of the Mohicans*; Irving's *Life of Goldsmith*; Macaulay's *Life of Johnson*; Macaulay's *Addison*; the *De Coverley Papers* from the *Spectator*; Carlyle's *Essay on Burns*; Burke's *Speech on Con-*

* By S. R. Carpenter, A.B.; Franklin T. Baker, A.M.; and Fred. N. Scott, Ph.D.

ciliation; The Ancient Mariner; Tennyson's *Lancelot and Elaine, The Passing of Arthur, Gareth and Lynette;* Milton's *L'Allegro, Il Penseroso, Lycidas, Comus; Macbeth.* The list is not clearly stated in the book, and some other books are given for reading only. With the exception of *The Last of the Mohicans,* which seems somewhat out of place, the selection deserves nothing but praise, as covering the principal varieties both in period and in style. The fault we find is that it is so all-embracing as to preclude any development of individual taste either in teacher or taught, and that the syllabus is not altered with sufficient frequency to prevent the teaching from becoming ossified.

Limited as they are by the syllabus prepared for them, the authors have sketched out a course of study which extracts from it its full value, and no important sidelight is wanting in their illumination of the subject. The same sympathy and the same enthusiasm are still apparent, and the hints given on page 181 in the elementary section and on page 277 in the secondary alike show a teacher's hand. We quote the former: "Browning's *How they brought the Good News from Ghent to Aix.*

"1. An introduction, giving Browning's account of how he came to write the poem.

"2. A brief comparison of it in theme and spirit with some of the ballads and other poems of action which the children have read.

"3. Call attention to the scene at starting.

"4. Note the galloping movement of the verse, and its fitness to the theme.

"5. Note the hurry of the action.

"6. By what means is the horse Roland shown to be the hero of the poem?

"7. How are the flight of time and the distance travelled given?

"8. Pick out (*a*) the vivid and effective scenes; (*b*) the lines whose sound is pleasing.

"9. What now appears to have been the author's own interest in the story—that is, his motive in writing it?"

We are pleased to see that in this section the authors lay some stress upon the value of prosody, a branch of the study of English which is greatly neglected in England, and a knowledge of which is absolutely necessary for a full appreciation of our splendid poetry. The study of Anglo-Saxon in the secondary school is hardly recommended by the authors, who appear to think that Latin is perhaps more useful. This is a conclusion with which we do not agree. A knowledge of both languages is undoubtedly necessary for a proper understanding of our native tongue, but an acquaintance with the elements of Anglo-Saxon grammar is not difficult to obtain, and is essential to a student of English. We would belabour the authors with their own arguments against Latin.

A few short chapters at the end of the book deal briefly with the training of the teacher, and with the Philosophy of the Assignment. In the first of these the aims of the training are clearly given. A full acquaintance with English language and literature, with Latin, Old English, and at least one modern language is demanded, and the attainment of the power of clear, vivid, and correct expression emphasised. To these are added a knowledge of comparative philology and of the psychology of speech. How far these objects are attained in England we all know; how far they secure them in the United States is shown by the authors in the paragraph which follows:—

"Certainly half our high school teachers of English have not had even college instruction in that subject, much less university instruction; have no special knowledge of the history of our language and literature; and are incompetent, from any rational point of view, to give instruction in their native tongue" (page 33).

The strangely-named chapter on the Philosophy of the Assignment deals with classroom procedure in teaching English, and with the question whether the English of a school should be in the hands of a special teacher, or should be distributed amongst the general staff. If the dangers of specialisation are carefully guarded against, and the tendency to push a pet subject into undue prominence is repressed, we prefer the special master.

As minor points of criticism, perhaps the authors will allow us, *pace* Dr. Thurber, to point out as oversights of expression—

"A work of literature is *an art*" (page 253).

"The process may be *well begun* in the elementary schools, and the *necessary foundations* may be laid in the high school" (page 60).

"Some of the speeches of Macbeth are *proverbial* for their high order of imaginative beauty" (page 278).

In sum, we have read the book with great interest and much profit, we recommend it to all English teachers as an excellent summary of their principles and aims, and are sure they will forgive all depreciation of our own England for the one sentence, "The teacher's obligations are serious, but they do not extend to martyrdom for rich cities that consider education cheap" (page 144).

INDOOR OBSERVATIONS ON THE SUN.

ALMOST interesting kind of nature study can be pursued all the year round in any kind of room which has a window through which the sun shines at some time of the day, and where the wonderful changes in the position of the shadow of a selected spot on the window can fall on either wall adjacent to it.

Two sash-bars or mullions crossing each other provide the best form of shadow, as it makes an angle acute, right, or obtuse. A neat, small angular mark made on the wall, where the shadow falls at a certain fixed time, provides the most accurate marking. If it fall too high to be reached, a spot of ink made by a rod whose end has been dipped in ink will overcome the difficulty. A tack or a drawing-pin placed in the angle of the shadow might be used instead of ink.

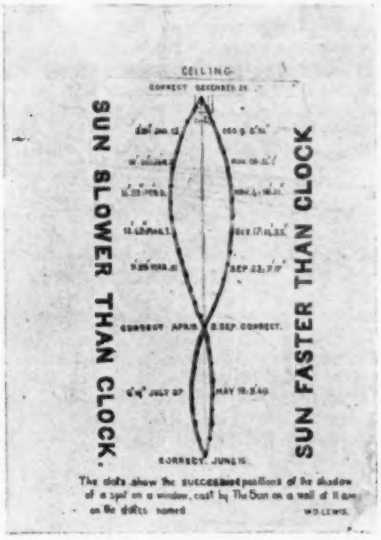
The time chosen for the observation must depend upon that time of the day when the angular shadow is clearly outlined on the wall. In a room with a southerly aspect observations could be taken morning or evening: for in my school there are observers every quarter of an hour from 10 to 11.45 a.m., recording the morning shadows; while others in the afternoon, between from 2.30 to 3.30 p.m., record on the opposite wall, thus giving thirteen sets of records. Records are made on about fifty or more days in the course of the year.

It must not be supposed that this takes up much time, for each observer has the same hour day by day allotted by a *rota*, and the process of marking does not occupy one minute at the time.

Strict, accurate Greenwich time must be used, for any want of punctuality on the part of the observer will lead to irregularity in the shadow marks.

What does all this lead to? It teaches us that at no time of the year will the shadow be so high up on the wall as at Christmas, nor so low as on June 21st; therefore the sun's lowest and highest altitudes will be on or about those dates respectively. Photograph 1 shows that for this series of observations (taken at 11 a.m. G.T., about fifty times in the course of the same year). To carry on similar observations let a portion of the window be selected about Christmas-time, when the shadow of two crossing frames throws its angle near to the ceiling. Mark this point as directed above. It is seen in the photograph on a corbel, the date in this and in other markings being stated. Once a week or so after, give the same child the responsibility of watching at 11 a.m. for this shadow, and the duty of placing a dot or small angle in the point of the shadow neatly and punctually. As time goes on these marks will be found to sink lower, week by week, until at June 21st the mark will be ten feet or so lower down on the wall than where it fell on Christmas Day. After midsummer no more depression takes place, for it is the time of the solstice (the standing of the sun), but in a few weeks a change can be perceived. The shadow has risen, and continues to rise day after day for six months at the same

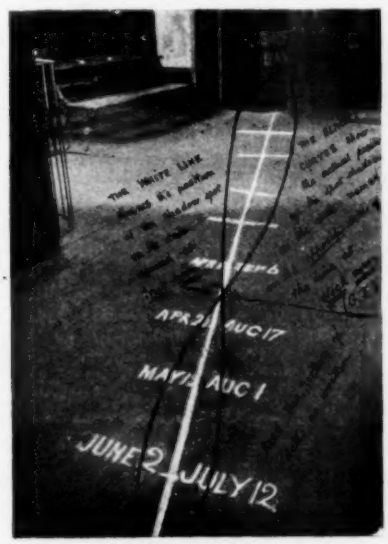
rate as it fell. The recording marks rise higher and higher. Anxiously the observer watches whether the slow elevation of the spots will bring the shadow of the selected spot back



PHOTOGRAPH 1.

to the corbel at the winter solstice. Yes, it does! where it apparently stands still for a few weeks, to repeat once more for another year the never-failing changes, down the wall and up again.

But these marks do not lie in one and the same vertical line, as might have been expected. When the dots are joined together, four curves are formed, making a figure of 8. Draw a vertical line on the wall, as seen in the photograph. Remember once more that every mark recorded an observation at 11 a.m. only, and not at any other time. If the series of shadows always fell on this vertical line at 11 a.m., then clock-time and sun-time would always coincide;* but if, as



PHOTOGRAPH 2.

appears from Photograph 1, the shadows day by day be further from the line, and to the left of it, this shows that the sun has been more easterly in the heavens than it was at the same time on December 25th. Each day this deviation increases until February 11th, when it is 14 minutes 25 seconds late before the shadows reach the central line. A quickening process now appears—apparent time approaching mean time—until on April 15th the shadow falls on the line, and both coincide. The sun soon gets "before the clock," crossing the line before 11 a.m. The difference continues, until on May 15th it has gained 3 min. 49 sec. Then the row of dots curves on the right of the line; but a slackening again appears, and on June 16th the solar day is exactly 24 hours mean time. This slowing proceeds for another month, and for the second time in the year the shadows are on the left of the line of mean time, being 6 min. 19 sec. slow on July 27th. Once more a quickening is apparent, and the spots approach the line, and by September 2nd correct time is registered by the sun. The difference between sundial time and clock time now increases with each day, until the greatest deviation in the course of the year occurs on November 4th, being 16 min. 21 sec. too soon in crossing the line. However, the last approach to uniformity sets in, so that by Christmas Day the shadows get home on the corbel, to soon begin the fresh race for another year.

Shadows on the Floor (Photograph 2).

For this purpose a room about 40 feet long would be required to show on the floor the varying positions required for a mid-day series. The white line marked on the floor can be seen stretching away into the porch. The farthest point is reached on the shortest day, and actually falls outside the building, about 45 feet from the window; while the altitude of the sun is so great on the longest day that the shadow of the selected spot is about 4 feet from its foot, on the floor. Pursue the same course of markings as on the wall, the same series of curves being shown by the black curves in the photograph, proving the same results as before. The same principles affect the deviation of the shadows from the mean time, as shown by the true meridian line on the floor.

Those who have seen these marks on the floor generally express their surprise at the wide range of the shadows.

PRACTICAL HELP IN THE ARITHMETIC LESSON.

BY GEORGE COLLAR, B.A., B.SC.,
Joint Author of "A New Arithmetic."

WE gave in November issue a few devices that will be found useful in teaching addition; we now propose to deal with subtraction.

Successful teaching of subtraction can only come from a recognition of its close relation to addition. The facts required to be known are the same in both cases. Both rules are based upon what we might call the "sum relations" of numbers—that is, a knowledge of the sum formed by two numbers—for example, 4 and 3 are 7. This and similar facts have to be taught to the children, and then questions in either addition or subtraction are simply exercises in applying the knowledge of the facts. In the case of addition the two numbers are given, and their sum is required: 4 and 3 are (how many)? In subtraction one number and the sum are given, and the other number is required: 4 and (how many) are 7?

If this be accepted as the fundamental idea in subtraction, several advantages at once become evident. (*a*) The two rules can be taught simultaneously, and each helps the other by presenting the same fact in two different ways. (*b*) The method of working subtraction is the *natural* one, as shown by the fact that it is the method unconsciously adopted in practice. If a tradesman sells an article for eightpence, and receives a shilling in payment, he never calculates the change by saying "8 away from 12 leaves 4," but "8 **and 4** are 12." (*c*) This method enables us to tell in one operation the difference between a given number and

* By sun-time astronomers refer to sundial time or apparent time, whereas a clock keeps mean time, and these are not necessarily coincident.

the sum of a series of others—a fact which makes its adoption universal among bankers and others who have to draw up balance-sheets. (*d*) It enables us to tell the difference between a number and the product of two others in one step, and so leads up to the quick method of long division.

We have shown elsewhere how utterly inapplicable to subtraction are the terms "borrow" and "pay back," and their use is slowly dying. Force of habit, however, among teachers seems to be responsible for the reluctance to adopt the method of complementary addition; but we have never yet found a teacher who has given the method a fair trial who is dissatisfied with the result, or who is not convinced that the method is superior. Teachers should adopt the method first in their own calculations, and then teach it their children. The method is applicable with even greater advantage to compound subtraction.

In spite of the fact that 14 stands for one ten and four units, few people regard it even mentally as a compound quantity, and hence in subtracting 8 from it, we do not usually think of the complement required to bring the 8 up to 10 (namely, 2), and then increase this by 4, to find the complement required to make 8 up to 14. We regard the minuend as a single number, and work in one step. Some people prefer to work in two steps, as above. In compound subtraction we must regard such a quantity as 1s. 3d. as a compound quantity, and the subtraction of 8d. from 1s. 3d. must be done in two steps. But we have a choice of procedure. (1) We may (*a*) reduce 1s. 3d. to a simple quantity, 15d., and then (*b*) find the amount to be added to 8d. to make 15d.; or (2) we may find (*a*) the amount required to make 8d. up to a shilling, and then (*b*) increase this number of pence by 3 to find the total number of pence required to make 8d. up to 1s. 3d. On the whole, the second is perhaps the better way, because, after a little drill in the amount required to make each number of pence up to 1s., the pupil thinks immediately of 4d. as the complement of 8d., and merely adds this on to 3d. to get the number of pence in the answer.

Examples in subtraction, both simple and compound, can easily be set, and we strongly recommend all teachers whose classes are not actually engaged in learning those rules to take them up during the month by way of revision, in order to introduce the complementary addition method of working, and it will be found that the time so spent will bear fruit in the increased skill shown in the other rules.

We shall now deal with one or two more types of problems.

A man bought 35 books, some of them at 5d. each and some at 7d. each, and found that he had paid 2s. more than he would have done had he bought the whole at 5d. each.

Here we explain to the class that the total excess payment of 24 pence is due to an excess of 2d. on each book bought at 7d. Hence there were as many sevenpenny books as there are twos in twenty-four.

Working: $24 \div 2 = 12$; $35 - 12 = 23$.

Answer: 12 books at 7d., 23 at 5d.

The problem might have been stated thus:—

A man bought 35 books, some at 5d. each and some at 7d. each, and paid 3s. 10d. less than he would have done had each book cost 7d.

In this case we should explain that the total deficiency of 46d. is due to a deficiency of 2d. on each book bought for 5d. Therefore the number of books sold at 5d. is the same as the number of twopences in forty-six pence.

Working: $46 \div 2 = 23$; $35 - 23 = 12$.

Answer: 23 at 5d. and 12 at 7d.

In order to fix the principle of the problem in the mind of the pupil, the teacher should not only have each of the following examples worked, but should require the pupils to construct another problem from the data in each as above.

1. A grocer sold a certain number of pounds of tea and a certain number of pounds of coffee. The total weight was 27 lbs., and the total price was 4s. 7d. more than the price of 27 lbs. of coffee. If each pound of tea cost 5d. more than a pound of coffee, how many pounds were there of each?

2. A manufacturer employed 160 men and boys, whose total wages come to £30 less than they would have done if all had been men. If each boy's wage is 15s. less than a man's, how many men and how many boys were engaged?

Problems involving this principle are often set in interest and stocks.

Example.—A man invested £1200, partly at 3 per cent. and partly at 4 per cent., and found that his annual income was £7 greater than it would have been had he invested it all at 3 per cent. How much did he invest at each rate?

Here we see that the difference between investing £100 at 3 per cent. and at 4 per cent. amounts to £1 each year. Therefore the number of hundred pounds invested at 4 per cent. will be £7 ÷ £1—that is, seven. £1200 − £700 = £500.

Answer: £700 at 4 per cent., £500 at 3 per cent.

1. A person invested £3700, partly at $2\frac{1}{2}$ per cent. and partly at 3 per cent. He found that his income was £8 less than it would have been if all had been invested at 3 per cent. Find the amount invested at each rate.

2. A man invested his capital partly at 3 per cent. and partly at $3\frac{1}{2}$ per cent. His annual income was £25, which was £4 more than it would have been if he had invested it all at 3 per cent. How much did he invest in all, and how much of that was at $3\frac{1}{2}$ per cent.?

3. A person having £2500 put part of it in a bank which paid $2\frac{1}{2}$ per cent. per annum, and invested the rest in stocks which paid $3\frac{3}{4}$ per cent. on the money invested. He received £12, 10*s.* a year more than he would have done had he put all his money in the bank. Find how much he put by in each way.

4. A person invested £4870, partly in 4 per cent. stock at 96 and partly in 5 per cent. stock at 125, and found that his income was £1, 2s. 6d. greater than if he had invested the whole in the 5 per cents. How much did he invest in each stock?

5. A greengrocer who had been selling apples at 10 for sixpence, raised the price to 8 for sixpence when he had sold half his apples, and by so doing made 2s. 6d. extra profit. How many apples did he sell?

6. A dealer bought a case of eggs at the rate of 16 a shilling. He sold three-quarters of them at twelve a shilling, and the rest at cost price, and made 4s. $4\frac{1}{2}$d. less profit than he would have made by selling them all at a penny each. How many eggs were there in the case?

Prize Competition

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PHYSICAL TRAINING.

A PROGRESSIVE COURSE FOR ELEMENTARY SCHOOLS.

BY H. RIPPON-SEYMOUR, A.C.,

Chief Instructor, George Watson's College, Edinburgh; Member International Congress of Physical Education, Paris, 1900; Author of "Physical Training," etc.

IN concluding this series of articles, it is now only necessary to give a few general rules and hints to readers as to the method and manner of imparting instruction.

It has been my object to give a good idea of the fundamental movements necessary to produce, in the first place, a gradual, harmonious development of the whole body; and secondly, to inculcate the desired smartness, promptitude of action at the word of command, order, obedience—all, in fact, that is meant by the word discipline.

Unfortunately, however, one cannot learn from a book the correct manner of imparting instruction in drill. Even the most perfect knowledge of drill of every kind is practically useless, unless one has the gift of command both in voice and in manner, and practice alone can give this.

The ability to produce a well-drilled class of young children is rarely found amongst ordinary teachers; by which I refer, of course, to those who are required to teach drill in addition to their other educational duties. The difficulty, therefore, is to obtain the necessary practice without experimenting on the children under one's charge.

For male teachers a volunteer training cannot be too highly spoken of, whilst for lady teachers the best plan is the formation of a class under a skilled teacher of drill, etc., who will, after a few lessons, insist on each member taking turns in giving the instruction to the others, under his supervision and guidance.

In smaller country districts, however, this class system may not be possible, and I hope, therefore, that the following hints may prove of some service to those of my readers whose sphere of usefulness lies in the country.

Where no actual system of physical instruction is laid down by the Board, teachers are free to devise their own kinds of drill and exercises in physical training, or they may have recourse to one of the many books on the subject.

In the eleven articles which have preceded this, sufficient material has been given, either to work on as a complete system, or from which a series of exercises in free movements, dumb-bells, barbells, and military drill can be arranged to suit the capacity of the teacher as well as of the pupils.

As a rule, the time at disposal for a lesson is limited to half an hour or even less. Bearing this fact in mind, it is advisable that all explanations of movements should be cut as short as possible, consistent with clearness. All positions should be personally illustrated by the teacher, or by one of the smartest of the pupils, before the class are ordered to perform the movement. In every class will be found some inattentive pupils, who, however, will generally *watch*, though they may not *listen*.

The lesson should be made as bright, amusing, varied, and instructive as possible, provided always that it contains the necessary physical value.

The word of command must be made either sharp or long-drawn, according to the kind of movement to be performed; for on the correct expression, decisiveness, and tone of the command everything depends.

Each exercise should be thoroughly learned "by numbers," and every position correctly performed before proceeding to its performance in "quick time." If a class be hurried on too quickly, the positions and movements are certain to be incorrect and faulty, and these faults are most difficult to eradicate once they become habitual.

This is most noticeable in exercises with a "lunge." Much practice is necessary to produce a good lunge, which loses half its value as a physical exercise when carelessly performed, as it too often is.

Speaking from experience, I should say that a lunging exercise is the severest test that can be applied to a class in drill.

The performance of exercises to music frequently tends to produce a slovenly method of working, due, no doubt, to the almost automatic action of the limbs. This, however, should not be the case if a class has been thoroughly trained in the movements without music.

A great deal, too, depends on the "time" of the air which is being played being suited to the exercise. Like the word of command, the time must suit the movement being performed.

Quick movements, such as the first and third dumb-bell and the first, second, and fourth barbell exercises, and, of course, marching, should be performed to "quick-march" time.

Slow movements, such as side-bending, etc. (second, fourth, and fifth dumb-bell, fourth, fifth, and sixth barbell exercises), should be performed to slow or, say, waltz-time music.

It is not desirable to have music for the free movements, as these are not intended to become automatic. It is now generally recognised that automatism in exercise does not have such a developmental effect on the body as when the will is brought into play. In performing free movements, therefore, *time* can be sacrificed somewhat, and attention paid rather to the fact that each pupil must "bend" or "turn" as far as he or she possibly can. A little practice, however, will soon produce quite a regular cadence in the performance of these free movements without in any way detracting from their efficiency.

Free movements have the great advantage of being so simple and harmless that they can be taken by *every* pupil, and only in extreme cases of weakness or physical disability should any child be excused them.

Class exercises have one disadvantage—namely, that either the work must be made sufficiently easy to suit the weakest pupil, or the weakly ones must be allowed to rest if exhausted, whilst the stronger ones continue the work. With free movements, however, this should not occur.

The class must always be allowed to "stand easy" after performing an exercise, even a rest of but a few seconds often being sufficient, because affording a "change of position." Insist, however, on absolute immobility whilst in the position of "attention." Such training is of the greatest use in the cure of many children affected with nervous movements of head or limbs.

The exercises should be varied as much as possible, in order to sustain the pupils' interest, but each exercise must be well learned before proceeding to another.

If possible, the exercises should be given daily, never more than half an hour at a time, even ten minutes' thorough work being of the greatest use.

The results of the training will soon be seen in the general appearance of the children; and the personal performance of the exercises by the teacher will, at the same time, have a most beneficial effect on him or her. In this connection I may perhaps be allowed to quote from the Report of the Royal Commission on Physical Training:—

"We have had evidence that, in respect of physique, the standard of those who seek to be male teachers has shown a tendency to decline. This is a matter of serious regret, and any condition which would require at least a normal standard of health and physique is one which cannot be deemed superfluous for those who are to bring the proper qualities of character and temperament to the work of the profession. Almost no other calling makes such demands on that elasticity and energy of spirit, which can hardly co-exist with defective physical condition.....We think that, as a general principle, in the case of all those proposing to enter the profession, it should be a necessary requirement that they should go through a sufficient course of instruction on the subject, and should be able to impart the essential elements of that instruction to their pupils."

It might add interest to the physical instruction if measurements of the boys were taken. Measurement of height is not so important as that of chest-girth and of weight, except perhaps that extremely rapid growth usually produces general weakness, and as a consequence such a pupil should not be allowed too much severe exercise.

In a recent article in this magazine, entitled "Physical Education," the writer advocates the measurement of the boys by each other. Such measurements can have but little

value, from the fact that the accurate measurement of the body can only be undertaken by an expert.

Not only must the tape be put round every pupil in exactly the same relative position, both at "weighing in" and "weighing out," but care must be taken that the pupil stands with the same air-pressure in his lungs on both occasions.

I have found from long experience that there is an unconscious tendency to "cheat" the measurer by over-inflation when supposed to be standing at the "normal," and it requires a keen and experienced measurer to detect this.

I would suggest the following table for measurement. It will give three capacities of chest, which, after all, is perhaps the most important part of the body to develop, for in so doing the limbs will develop synchronously.

Measurements might be taken at the beginning and end of each session, in a book kept for the purpose; and in order to interest the pupils in their progress, they should be informed of their development.

Finally, let the teachers' example be ever before the pupils in their carriage, their personal bearing, their standing, or their sitting; for still, as ever, "example is better than precept."

The author will be pleased to answer in these columns questions of general interest on drill and physical training. Letters should be addressed to the **Author, care of the Editor,** *and must enclose the coupon on back page of cover.*

Dates.		Neck.		Chest Maximum.		Chest Minimum.		Chest Normal.		Right U. Arm.		Right Forearm.		Left U. Arm.		Left Forearm.		Height.	
		In.	8ths.	In.	8ths.	In.	8ths.	In.	8ths.	In.	8ths.	In.	8ths.	In.	8ths.	In.	8ths.	Feet.	In.
Commenced.....																			
Finished.....																			
	Increase.....																		

A SERIES OF LESSONS ON A QUARRY.

ARRANGED ACCORDING TO THE "FIVE POINTS" OF HERBART.

BY W. D. LEWIS.

Stage V.—The Rising of the Strata out of the Sea into their present Position.

Preparation.	Presentation.	Association.	Formulation.	Application.
Elevation very general. Revise the subsidence of the land and the positions of the strata after subsidence.	Deduce the necessity of elevation before the rocks could occupy their present position.	Compare the elevation of the Himalayas, Andes, Alps, etc.	The land has not only subsided in different places, but it has also been raised out of the waters.	Write an essay on the lifting up of the rocks.
Rate of elevation. How do we know that the rocks of this quarry and the country around here had sunk? Recall the order of subsidence.	Upheaval, like subsidence, is very slow. The Baltic rises four feet in a century, which is a rather rapid rate of elevation.	Contrast the Chili coast elevated 220 feet in nineteen years; the boat rings of the Moravian settlers in North America.	Elevation is slow; perhaps only a few feet in a century.	Work out problems in number, to find the time required to elevate certain heights at this rate.
Raised beaches. The deposits now found at sea level and in lakes.	Raised beaches; layers of sea deposits up to over 100 feet above high-water mark show rows of pebbles, shells, etc.	If on the sea-shore, a class visit will possibly provide opportunities for seeing these raised beaches.	Raised beaches, showing tidal deposits above high-water mark, are evidences of the elevation of the land.	Drawings of cliffs with raised beaches from a teacher's blackboard sketch or from nature.
Inclination of strata. Bring up the knowledge of the terms "horizontal," "inclined," "vertical," and hold books to illustrate each position.	The strata were first deposited horizontally, but much of this everywhere is now inclined.	"Fluids find their own level." Associate this truth with deposits and strata.	Although the strata were deposited horizontally, much of them is now inclined.	Any other cuttings, quarries, cliffs, etc., which show a different arrangement, could be visited, and rough sketches, etc., made, to illustrate the children's ideas of stratification.
The quarry fault. Make a rough model of a brittle substance, as bread. Cut through for fault. Rub the faces together to show fracture. No crumbling unless one side sinks more than the other.	Note the two inclinations in the quarry. Deduce that at the locality of the fault there must have been subsidence, for both sets of strata slope towards each other.	The left side has sunk more than the right. Compare by the photographs. These fractured portions more susceptible to "weathering" than the unbroken strata. Perhaps the beginning of future valleys. Take a piece of cardboard; bend it into a few parallel folds.	A subsidence has taken place in one part of the quarry, forming a fault, thus interrupting the continuity of the stratification. Valleys may commence in a fracture across country, where denudation produces a greater effect upon the surface.	Use models made in the last lesson; cut through for a fault; slide the one face of the fault over the other, depressing the left more than the right. Scoop out valleys of denudation, valleys of dislocation, valleys of elevation, from the model, and let the children read the succession of strata.
The formation of valley. The deepening of river beds. Recall evidence to prove this. Yet hardly within the memory of any living person.	As the rocks were elevated the valley was scooped out by the running stream, now 250 feet below the quarry.	Note the cracking at the summit of the fold, and compare it with the cracking underneath. Thus an example of sources of weakness.	Valleys were made as the land was elevated, the river beds deepening, and the sides washed away by rains, landslips, etc.	Make a model of river terraces.

THREE RECITATIONS FOR INFANTS.

KING ARTHUR'S LITTLE KNIGHTS.

BY SISSIE TURLEY.

MANY, many years ago,
Books and poets tell us so,
In this land there ruled a king,
And his praises still we sing.
King Arthur was his name, and his knights were true;
They swore to serve the king and his will to do.

It was such a wondrous sight,
When King Arthur made a knight,
As the lord on bended knee
Promised a true knight to be.
As gentlemen they tried to act, in thought and deed;
They lived to help the weak or a friend in need.

All oppressed King Arthur sought,
Ladies too their troubles brought;
Then the knights were sent in haste,
Every one in steel encased.
They rode on prancing steeds, and their armour bright
Glistened as they passed in the bright sunlight.

Each of us may be a knight,
Though the foe we have to fight
Does not ride a prancing horse,
Has not to be slain by force.
We try to change and conquer every evil thought;
A harder, longer fight than the old knights fought.

All the birds, the fish, the flies,
Every animal that tries
To escape a cruel blow
Needs protection. We may show
That knights are living still, and these knights are true;
And though we are quite young, noble work we do.

THE PEOPLE AT HOME.

BY SISSIE TURLEY.

THE queen of the household is mother;
Her subjects are loving and loyal,
Though our cottage is not quite a palace,
And her work you would hardly call royal.
For the mending and patching and baking
Have all to be done day by day;
But when I am earning some money,
We will manage a different way.

A pony and trap will come dashing
Up to the front of our house;
Mother's eyes will be twinkling and flashing,
While I sit as still as a mouse.
At last I will turn with a glad smile,
And say, "We have bought this for you;"
If I save hard before I am thirty,
I hope that this dream will come true.

The king of the household is father,
As kind and as good as the queen;
He is really more fit for a monarch
Than any one else I have seen.
All the day long he is working
For mother and baby and me,
Helping to make the large vessels
To carry folks over the sea.

But now I must talk of the princess,
With her lady-in-waiting—the cat;
She is three years old, and a baby,
Mischievous, happy, and fat.
Each day she rides out in her carriage,
You call it a mail-cart, of course;
But her little royal highness, the baby,
Prefers it to one with a horse.

And I am the prince of the country,
With a penny a week for my pay;
For this sum I brighten the silver,
And clean royal knives every day.
I hope that in all other houses
The court is as fine as our own,
Though the palace is only a cottage,
And a rocking-chair serves as a throne.

A MESSAGE FROM NATURE.

BY SISSIE TURLEY.

THE sea comes roaring and dashing against the rocks on the beach,
The waves are falling and splashing, until my castle they reach;
And soon this is lost in the ocean, and I run back with a cry,
And think, as I watch the strange motion, what a tiny wee creature am I!

The next day the sea is much calmer—the waves are just kissing the sand;
Surely to-day I am master—master of all the land.
But slowly the waves come in creeping, my fortress I leave with a sigh;
Before this great force, never sleeping, what a tiny wee creature am I!

And now far away from the leaping and creeping and sad weeping sea,
I stand in a beautiful forest, while the birds sing a carol to me.
The rain soon descends in a shower, so under an oak tree I lie,
And think, as I look at its power, what a tiny wee creature am I!

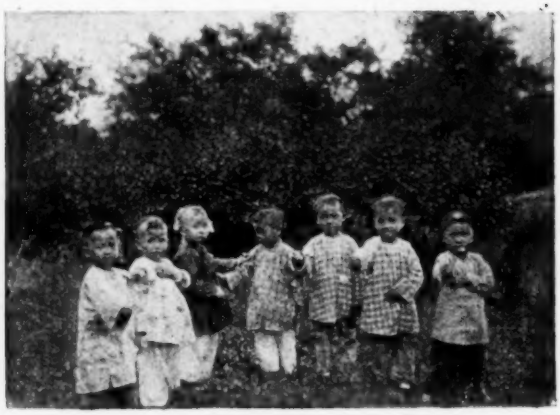
It must have seen hundreds of summers, while I have been here only seven;
The birds singing on the top branches can surely peep right into heaven.
Perhaps the angels are teaching the birdies their songs in the sky;
Under the branches far reaching, what a tiny wee creature am I!

Yet still I am greater than ocean, and greater, far greater, than trees;
For a soul is living within me, which only the great Father sees.
The trees, rocks, and seas have their beauty, but never can think, never speak;
I can do more than my duty, if more than my duty I seek.

And every action of kindness, and every thought for our friends,
Is making the soul more lovely with a beauty that goodness lends;
And this soul will live when the waters have ceased to break into foam,
When all God's sons and daughters are called to His own bright home.

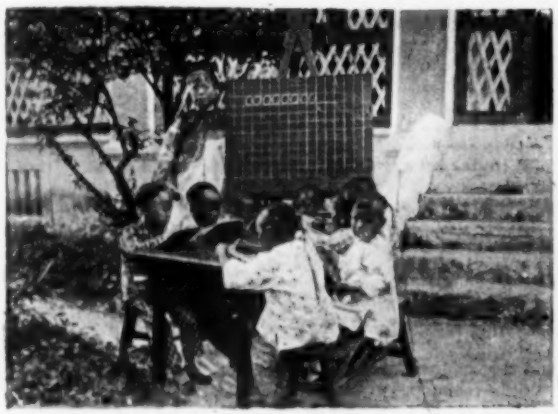
A CHINESE KINDERGARTEN.

"GOOD-MORNING, TEACHER."



ACTION SONG.

PLAYING WITH FROEBEL'S GIFT III.



LEARNING TO WRITE "O'S."

KINDERGARTEN PUPILS OUTSIDE MRS. WALES'S HOUSE.

A CHINESE KINDERGARTEN.

LAST August the writer found himself in Amoy, China. Among the wonders of the Chinese Empire he found a kindergarten school. Our readers may be interested in a few illustrations of this interesting experiment. A year or two ago it occurred to Mrs. Wales of Amoy that a class of this kind would appeal to the Chinese themselves. Each year the attendance and interest in it has much increased. This year she has had various applications from Chinese citizens asking her to send teachers to establish similar schools in different parts of China. The social customs of the people to some extent prevent her acceding to these requests. After she has trained a young Chinese girl as a teacher, ere long the maiden *must* marry. At present she has an excellent assistant, whose portrait will be seen in the illustrations. A short time ago this Chinese teacher gave a public entertainment with her kindergarten children, and the "demonstration" gave great delight to her Chinese audience. Even in that country of wonders this must surely have been a unique entertainment.

When giving you a salute, the man of China shakes hands with himself. In illustration No. 1 the bright little youngsters are saying, "Good-morning, teacher." The action song in No. 2 is to illustrate "Hands are made to work and not to fight with." The centre illustration shows a five-year-old class playing with Froebel's Gift III. The young penmen in picture No. 3 are busy with the letter O. There are ardent patriots among "young China." In the last illustration they are at flag drill. After the war between Japan and China, while at this exercise the teacher held up the Japanese flag (they are learned in the flags of all countries). On her asking what flag it was, the immediate reply came, "Bad-smelling Japanese flag!"

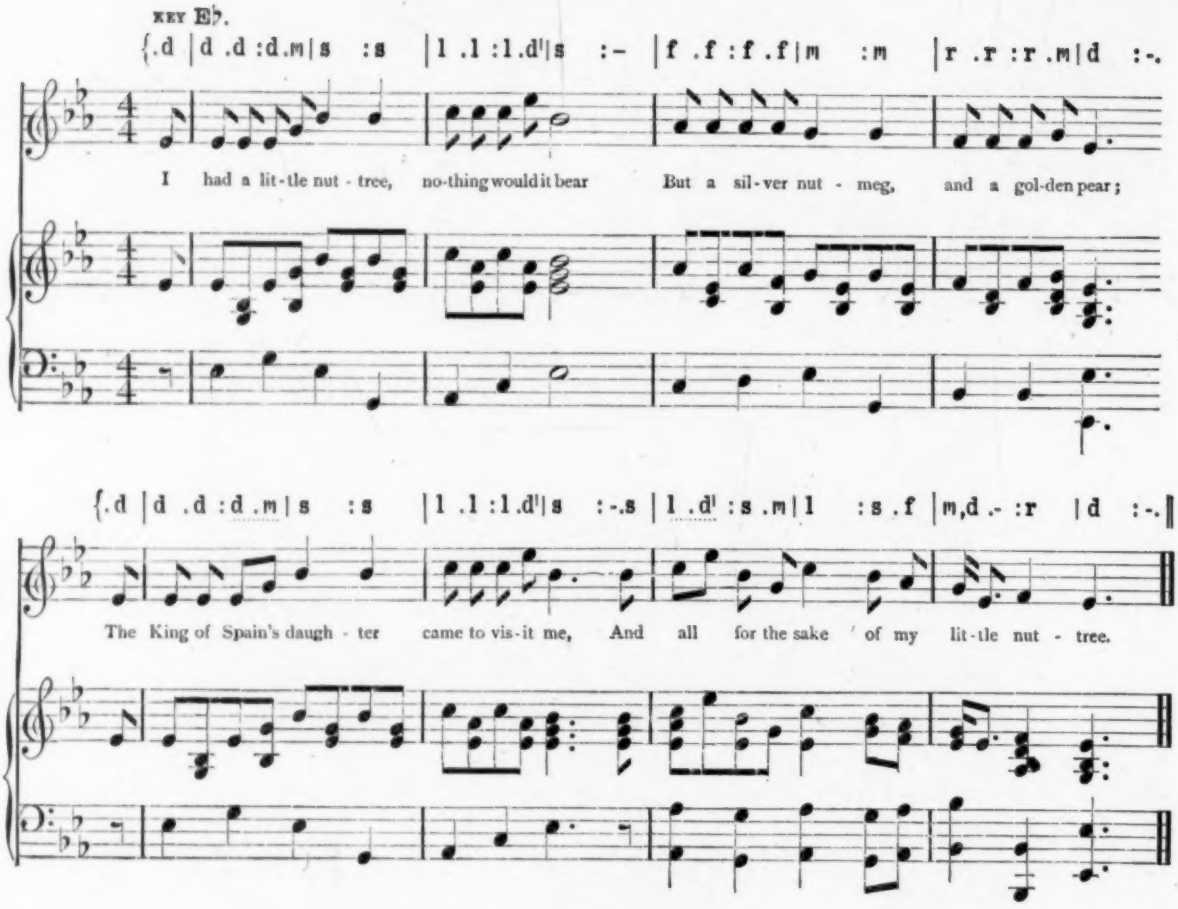
FLAG DRILL.

China has many surprises in store for the western nations. Her educational development will not be among the least of these. All interested in kindergarten extension will wish Mrs. Wales and her Chinese assistant still more extended success in their useful labours.

THE RELIGIOUS DIFFICULTY IN THE SCHOOLS.—Under this title Mr. Cloudesley Brereton contributes a very thoughtful and suggestive article to the *Daily Chronicle* of December 3. He makes a series of propositions, in the hope of removing the religious difficulty from the field of educational policy. He considers that "all who are genuinely interested in national education regret to see primary education directly suffering in some counties from the inability of the rival denominations to find a *modus vivendi*." He objects to the proposal to purchase or rent the denominational schools on the grounds (1) that it does not meet the views of the Roman Catholics and of many of the Anglicans; (2) that it would be extravagant in its cost, the outlay being about £40,000,000, or a yearly charge of about £1,120,000 a year; (3) that there would be no finality about it, and the dispute would continue in a more embittered form; and (4) that secularisation of the schools, such as exists in France, is not a question of practical politics in England.

The constructive proposals are that each denomination should have the right of entry into the public schools. Mr. Brereton proposes that the state should pay a certain number of "school chaplains," who might be either in orders or laymen. He feels that it would not be practical to ask the state to provide a chaplain for just one or two individual children in a particular school, but thinks that twenty or five-and-twenty would justify such an appointment. He would retain in the system the right of parents to withdraw their children from religious instruction altogether, if they so desired, and would treat the League of Moral Instruction as though it were a religious denomination. Chaplains would be nominated by the bishops in the case of Anglicans and Roman Catholics, and by the Free Church Councils in the case of Dissenters. He suggests that the religious instruction might be given on a Saturday, as that would make it possible for a "chaplain" to visit one school in the morning and another in the afternoon. In this way he thinks that three chaplains would be able to serve on the average two schools. Allowing £15 a year as the bonus to be paid, the cost to the Exchequer would be about £450,000 a year, but would be less if the state required that the managers of non-provided schools who insisted on appointing a head teacher of a particular denomination should bear the cost of the religious instruction in the tenets of that denomination.

It is, of course, impossible to give an exact estimate of the cost under such circumstances, and, moreover, the cost is not the principal point to be considered if we can only induce the various religious bodies to agree upon a plan which will make religion a motor force in the education of the child, and not a hindrance to it. We think, however, that those who have watched the difference between the skilled teaching at present given in the day schools, and the ineffective though deeply earnest instruction often given in the Sunday schools, will prefer that the religious teaching should remain in the hands of teachers. Of course, this will be possible under Mr. Brereton's scheme, which deserves the careful consideration of all who are interested in the settlement of the difficulty.

THE LITTLE NUT-TREE.

KEY E♭.
I had a lit-tle nut - tree, no-thing would it bear But a sil-ver nut - meg, and a gol-den pear;
The King of Spain's daugh - ter came to vis-it me, And all for the sake of my lit-tle nut - tree.

1 I HAD a little nut-tree, nothing would it bear
But a silver nutmeg, and a golden pear;
The King of Spain's daughter came to visit me,
And all for the sake of my little nut-tree.

2 She gave me Spanish money for the golden pear;
For the silver nutmeg, jewels rich and rare.
She took me off a-sailing, far across the sea;
But weary did I grow for my little nut-tree.

3 So back the ship came sailing o'er the shining foam,
To my pretty garden, and my happy home.
My little tree was blooming, fair and dear to see;
And oh, I'll never leave thee, my little nut-tree.

The actions here must be few and simple, serving merely to indicate the various objects mentioned in the song.

"LES TROIS VILLES."

BY A. E. STYLER.

FOR more years than it would be prudent to say, I have attended holiday courses, wandering far afield into Switzerland and Germany, and neglecting those held near home in Normandy. This year, however, four of my own pupils were happy winners of County Council exhibitions, and I therefore resolved to pay a round of visits in Normandy, in order to note what they were doing. My original plan was to see a little of all the courses, but there was only time to visit Lisieux, Caen, and Bayeux—three quiet towns admirably adapted for study. Everywhere the professors gave me absolute freedom in attending the classes, and my heartiest thanks are due to MM. Féquet and Hardy of Lisieux, to M. Lebonnois of Caen, and to M. Godal of Bayeux.

Lisieux.

At Lisieux I arrived just in time to join the students in their ramble round the town; and it was soon evident that our guide, M. Féquet, like most good teachers, understood the value of humour. Lisieux is a spot to be recommended to the language student who is also fond of photography and sketching. The crooked lines of the ancient wooden houses, that seem to nod with the sleep of centuries, are a treat to the eye after the commonplace primness of a London suburb. The classes struck me as being specially suitable for beginners. There were only about twenty students present, and two professors. This is a state of things which gives the individual learner an immense advantage, though rather discouraging for the teacher. Both M. Féquet and M. Degrenne are exceptionally patient, and spare no pains to make their French plain and simple. The classes are held at the college, and should they develop as they deserve to do, there will always be abundance of space in the numerous classrooms.

The three hours' work begins at 8.30 a.m. Practical exercises, such as reading, pronunciation, and dictation are taken first, followed by a short and easy "lecture," and conversation in small groups of four or five persons. Really advanced students were very few, so that the work was of the right kind for those present. Personally, however, I do not believe in foreign courses for those whose reading is limited, whose vocabulary is scanty, whose pronunciation is all wrong, and whose ear is untrained to French sounds. Such students always return home disappointed or even disgusted with the result of their month's work. For example, students should always endeavour to raise themselves above the dictation stage before going to France for a holiday course. Dictation is no doubt a valuable training for the ear, but, as a lesson, it is inevitably and incurably dull, and therefore to be avoided, above all in holiday time.

Further, I would advise abundant reading—aloud—and minute study of the pronunciation. Then the student need not fear a genuine French lecture, lasting forty-five minutes, and delivered deliberately but not too slowly. To strive hard to follow such a lecture should be one of the chief parts of a student's work in France. The very short and easy addresses given at Lisieux were suitable for students of limited vocabulary and untrained ear, but it seems to me that this stage should be passed before one attempts to derive benefit from a short holiday course in France.

Pronunciation was taught at Lisieux without phonetic symbols and without detailed description of the organs of speech, their positions and movements. The conversation groups being small, and both professors infinitely patient, good progress would probably be made here by most of the students. The professors had the happy knack of leading their pupils to speak of the things which were most familiar and interesting to them. For example, the teachers who were present were never so fluent as when describing their own schools.

In the afternoons there were excursions, and occasionally an extra lecture. One of these, given by M. Chevalier, I had the pleasure of hearing; and I afterwards found that many students had not had sufficient experience of French to follow the speaker, although his delivery was quite clear and deliberate. The students at Lisieux seemed very happy and interested in their work, and, for myself, I passed so pleasant a week there that I can strongly recommend the course to others.

Caen.

At Caen I found a large company of students gathered, including many who could themselves have delivered an address in French, if called upon. M. Lebonnois will perhaps include this useful exercise in his next year's programme. The courses, as at present organised, afford an earnest student splendid opportunities for improving rapidly in French. Since I visited Caen in 1897, great changes have been made, and, thanks to the energy of M. Lebonnois, these courses are developing rapidly both in numbers and efficiency. At Caen it is one's own fault if the day is not well filled. There are three hours of varied and interesting work in the morning, excursions in the afternoon, and a lecture every evening. I was busy either speaking or hearing French the whole day long; and the sturdiest, most insatiable of learners will find a full and many-sided programme awaiting them. Those with a smaller capacity for holiday work will know how to safeguard themselves against over-exertion.

MM. Lebonnois and De Martonne are both excellent speakers, and I enjoyed their lectures very much. They usually begin very slowly and deliberately, becoming more voluble as they proceed, and at times rushing along at express speed. Probably only the most advanced listeners would follow the lecture throughout, but that is inevitable. What pleased me most at Caen was this abundance of opportunity for training the ear. That is what the English pupil needs. If his reading has been extensive, and his store of words and phrases abundant, his ear soon grows quick and keen. But no one can catch such phrases as *au pied levé* or *battre à plate couture* unless they are already familiar.

Strange to say, a rumour had been current that the courses at Caen no longer existed. How the strange tale originated it would be hard to say, but certain it is that the courses at Caen are more flourishing than ever, their organisation comparing very favourably with the courses held at Geneva; and that is high praise.

M. Lebonnois is anxious to afford every facility to English teachers who desire to take over parties of their pupils—young people of from thirteen to sixteen. Such pupils are certainly of the best age to acquire rapidly both conversational readiness and a good French pronunciation. A month at the Caen courses cannot fail to bring pleasure and progress, especially to the energetic worker. After three hours of lectures and practical exercises in the forenoon, he can easily arrange to spend the afternoon in reading or

conversation with a French acquaintance, after which another interesting lecture completes the well-filled day. The learner who pursues this programme for a month, with an occasional rest, according to his need, will make very rapid strides. As a young German pupil of mine used to say, "You work at the English until your head is ill, and then you lie in bed till he is well again."

Bayeux.

At Bayeux about forty-five students were present. The most striking characteristic here was the splendid *swing* with which the programme was carried out. First, the study of French pronunciation conducted by M. Léon, then dictation and composition by M. Godal, and historical grammar by M. Lematte, the three professors following one another with clockwork regularity and with no interval to waste the time. I found this an excellent arrangement, for the change of teacher prevented any feeling of weariness or monotony. The class then divided for a lecture and conversation, M. Godal taking the elementary, M. Léon the intermediate, and M. Lematte the advanced division. The subjects taken were (1) Normandie et Bretagne, (2) Le Roman au XIX^{e} Siècle, and (3) Littérature et Histoire. M. Lematte is a most vigorous and eloquent speaker, whose oratory produced in me the same sensations of keen pleasure as those I felt at Jena when listening to the famous Dr. Rein. M. Lematte's programme ranged from "La Chanson de Roland" to our own times—"L'Europe et la Paix armée."

MM. Godal and Léon have the immense advantage of knowing English thoroughly, and one could constantly note how this knowledge guided them in detecting English faults and removing English difficulties. M. Godal was indefatigable in marking and criticising the written composition of the students. I had an opportunity of seeing some of this written work, and could not help admiring both the scrupulous marking of the teacher and the good work of the pupil. M. Léon taught the French sounds by means of a systematic succession of letters, syllables, words, and phrases, without the modern system of phonetics—for example, *ien ; bien, lien, rien, gardien, Prussien ; ton chien est fidèle.* His method was simple, rapid, and effective.

French Classics.—And now, having given a general description of the conditions of holiday study in the three old Norman towns, it is time to cull some practical observations from the heterogeneous mass which has accumulated in my notebook. It will probably shock many readers on both sides of the Channel when I state my firm conviction that the reading of the French classics is not so beneficial to the practical student as the French of the nineteenth and twentieth centuries. In listening to the professors as they expounded the works of Molière and Racine, one could not help remarking how frequently it was pointed out that a certain word or phrase was obsolete or greatly changed in meaning. Until his knowledge of useful, everyday French is firm and fixed, all these archaic expressions are an embarrassment to the English learner. Moreover, the classics are so abundantly annotated and so readily accessible that he can easily study them at home, *after* acquiring thoroughly the French of to-day.

Composition.—It has already been mentioned that dictation plays an important part at these courses, and that the students might with advantage spend their time at something more advanced, if they could manage to pass the dictation stage before going to France. It seems to me that composition is the exercise most needed—composition written in one's spare time, corrected by the professor, and criticised in class. This is the kind of work which M. Godal was doing at Bayeux ; and, naturally, the more proficient the students are at dictation, the more composition can be substituted. This would have its effect upon the conversational powers of the student, for written composition is a sort of slow, careful talking. Every essay written and well corrected supplies the pupils with material for conversation.

Conversation.—Everywhere the organisers of the courses had made the groups small, so that each individual might have an opportunity of saying something ; nevertheless, it sometimes chanced that one loquacious young lady would do nearly all the talking, to the detriment of the rest. In other cases, when the students lacked initiative, ingenuity, mental activity, or whatever it is that keeps the ball of conversation rolling, the talk would gradually fall more and more to the professor, and thus become a lecture. Many earnest students, unaccustomed to spoken French, seemed anxious to prepare a definite subject, set beforehand. This is a good plan if a book like *French Daily Life* (Dent and Co.) is used ; but if such a student attempted to get up the subject from a dictionary, he would probably make himself unintelligible by speaking in English phrases translated literally into French. Very few students seemed to understand that the power of conversation grows from abundant reading, and from the habit of gathering and storing useful words and phrases as they occur in the text.

Phonetics.—Although I have found the modern system of phonetics of great service, and am by no means an enemy of the system, yet I have reluctantly arrived at the conclusion that its advocates and teachers go too far, now that the system is coming into vogue, and so illustrate the folly of over-elaboration. Every reasonable person will admit the usefulness of the systematic phonetic signs, as a means of distinguishing, classifying, and "labelling" the sounds of a language. But some teachers of phonetics appear to think that they have only to give a long-winded description of the position and movements of the organs of speech required to produce a given sound, and the learner will produce this sound forthwith. One might as well expect a novice to put on a pair of skates, and, without more ado, cut an elaborate figure on the ice, just because he had read the instructions in a skating manual. After wide comparison and observation, I have found that a person with a fine ear can imitate with sufficient accuracy without physiological description of the unseen organs of speech ; whereas a person of duller ear may listen in vain to long and minute explanations of the action required to utter a certain vowel, and still persist in pronouncing the vowel incorrectly. A young Frenchman of my acquaintance sometimes amuses me by mimicking the voice and pronunciation of the ordinary young English lady, speaking French with a typical English accent ; he will then change to the French of a German Jew, and so on *ad lib.* Yet this young mimic is quite innocent of phonetics—does not even know the international alphabet. At Caen, the only town where I found phonetics on the programme, I was greatly interested in the course given by M. Coullet, especially when he was struggling with such a difficulty as, *meule* [mœl] = *pierre de moulin ;* and *meule* [mø:l] = *tas de foin.* It seemed to me that the difficulty was not removed in the least by the physiological description of what to do with this, that, and the other muscle. Persistent repetition and constant imitation is the only method—the guess and trial of the child who is learning to talk. Moreover, life is so short, and the study of a foreign language so many-sided, that it would be well to avoid losing oneself in the maze of these *chinoiseries phonétiques.*

Word Accent.—Many teachers there are who both learn and teach that the stress of voice falls upon the last syllable of a French word ; and that done, they think their duty ended. The fact is, however, that this question of the normal accent of a word, with its modification and displacement, is a most complicated one. Students should read the chapter in *Les Sons du français,* par Paul Passy, pp. 43–53, and then note the following curious cases collected from the speeches heard during my tour of the three towns : *Cónscience, existence, rôman, Cándide, nâturel ; expliquer, remârquer, mânger, plónger.* In some of these, the displacement may be accounted for by the presence of the nasal or other long sound ; but others are not so easily explained. This is an important detail of French study which we English are apt to neglect, and for that reason I mention it here. Intonation is another point which ought to be carefully noted by English students in France, for there it can be learned in the best of ways—by listening carefully to good speakers. It should be observed, too, that a Frenchman's method of speaking slowly is not what an Englishman would expect. It is done, not by separating the words, but by prolonging the syllables and sounding the unaccented *e*'s. This was particularly noticeable at Lisieux, where the professors were exceptionally careful in trying to make themselves intelligible. The

opposite of this slow speech may be seen in the light, witty, conversational sketches by Gyp, where these unaccented e's are elided completely.

Excursions.—These are usually pleasure parties pure and simple. The students often revert completely to their native English, and make little or no attempt to utilise the splendid opportunity of speaking French. This year I did not join in many of the excursions, because I dislike going over old ground; but in wandering round Lisieux with M. Féquet's party, I was reminded of a method practised at Jena with admirable effect. There a plan of lessons was drawn up to correspond closely with a series of interesting excursions, and printed leaflets contained the summary of what was discussed first in class and afterwards during the corresponding excursion. This was a plan which made it possible for even the most backward student to say something, if it were only, "Jena is an old town." At Lisieux I noted what might be termed the embryo of this same plan. M. Degrenne one day described in class, very clearly and simply, the chief things which would be seen during a coming excursion to Caen, so that the students were prepared beforehand and supplied with material for French conversation.

French as an Instrument of Thought.—At home our students are constantly translating—that is, substituting English thoughts for French ones. At holiday courses there is ample opportunity of thinking in French, and expressing one's thoughts directly in French. First, the lecturers are constantly giving definitions, or explaining in easy French the unfamiliar words met with: *Ramier = pigeon sauvage; succursale = établissement qui dépend d'un établissement plus grand; l'âme humaine = un principe inconnu, des faits connus que nous sentons en nous.* Next, proverbs are expounded or illustrated by examples. M. Lecouvey at Caen turned this kind of exercise to very good account: *Qui dîne de vanité, soupe de mépris; quand on veut noyer son chien, on dit qu'il est enragé.* The exercise termed *compte-rendu de lecture* is also eminently practical and useful. The students relate what they have read, or discuss the characters of the work under study. M. Lebonnois's class was engaged upon a tragedy of Racine, *Britannicus*, which afforded abundant material for argument and analysis. I noted that some students here were doing excellent work, and that the most advanced ones were also the most assiduous in attending the evening lectures, which proves what a fascinating study a foreign language is, and how the charm of it grows as we proceed.

Grammar.—M. Lematte (Bayeux) was very amusing when he set himself to expose the follies of the grammarian. Here is a grave question, for example: Ought we to write "*sirop de groseille*" or "*sirop de groseilles*"? The grammarian's verdict is that we must use the singular if the gooseberries are crushed, and the plural if they remain whole. So there is one important question settled. M. Lematte advises teachers to take no notice of the "*tolérances*," which he regards as mere rules for the guidance of examiners, and intended to prevent the loss of marks for unimportant grammatical errors. This is the policy I had always adopted with my pupils, so that I felt pleased to hear my opinion confirmed by an experienced French teacher. Any plan of grouping words is a great aid to the memory, and therefore worthy of the attention of the foreign student. M. Lematte would choose a certain word and trace it through its manifold meanings, derivatives, and combinations, until he had formed quite a long list. For instance, PAS, *Pas de Calais, Maupas, le Mauvais Pas, passer, se passer, se passer de, passage, les Passages à Paris, un passage d'oiseaux, passager, passoire, passeur, dépasser = passer en avant de, dépassement d'argent, dépassement de crédit, outrepasser, il a outrepassé ses droits, le passé, le présent, l'avenir, une passée de lièvres.*

He also had a pleasant custom of inviting students to choose for themselves any special difficulty as the subject of the next lesson. It was in this way that he was brought to discuss the rules for the French subjunctive and the characteristics of French poetry. In the former case I could not help noting that to an educated Frenchman the use of the subjunctive becomes a matter of instinct, and that he dwells more upon the general principle than upon the multifarious rules in which the English student puts his trust. His pleasant talk on French verse was very helpful, especially as everything was made clear by means of examples:

Cessez de vous troubler | vous n'êtes point trahi.
Quel avantage a-t-on qu'un homme vous caresse,
Vous jure amitié, foi, zèle, estime, tendresse?
Le jour n'est pas plus pur que le fond de mon cœur.

But in endeavouring to make this paper severely practical, I am forgetting that there are many teachers who never attend holiday courses, and whom I ought to be trying to "convert;" while there are many more who miss at these courses all the best of what they ought to gain. To the former I would say that in no other way can a teacher spend so varied a holiday, or leave more completely the narrowing groove of his ordinary work. Those who feel dull would find unending amusement and interest in a systematic study of French character, as compared with what they know of their own and other nations. After spending several holidays in Germany, I was struck more than ever by the unceasing gaiety of the French—gaiety which is not frivolity, but rather restless vitality—their cleverness as talkers, their light-hearted way of refusing to take things too seriously, and the startling transition to almost volcanic passion when anything really touches them. It is perhaps owing to this national trait that newspapers and politics are tabooed in French schools. Politics in a *lycée* might lead, not to the formation of a sober debating society, but to fierce fighting behind miniature barricades.

English students have an unfortunate tendency to congregate in a good hotel, where they constantly use their mother-tongue among themselves, and so learn little of French life and language. Yet among the French one constantly meets with interesting types. There is the charming old lady of the Empire, with her simple Catholic faith, her reminiscences of the siege of Paris, and her scant respect for latter-day manners. There is the inveterate punster, who will never let you forget that French is *la langue du calembour;* who will burst a hole in a sheet of paper and ask you how it resembles the Vatican! (*le papier crevé = le pape y est crevé*). There are the peasants of Le Bessin, whose old-world superstitions M. Vitasse describes so well. And when you are weary of hearing in the lecture-room of Montaigne and his essays, of Voltaire with his strange whims and great intellect, of Victor Hugo labouring in the *chambre de verre* of his Guernsey home, you can roam the country on your bicycle, or go boating on the quiet river and listen to your French friends as they sing, "*Bon soir, Madame la Lune.*"

DIFFICULTIES OF FRENCH IDIOMS AND CONSTRUCTIONS.

IV.

Préjudice is not, as in English, an unreasonable feeling conceived against some person, but a wrong done to a person or thing. Thus La Rochefoucauld says: "*On blâme l'injustice, non pour l'aversion que l'on a pour elle, mais par le préjudice que l'on en reçoit.*" "Prejudice" in the English sense is in French *préjugé.*

Préparation and *préparatif* might in a similar way be confounded. The former word refers to the *act* of preparing, and also to medicinal and chemical compounds. Thus we may talk of *une préparation chimique ou pharmaceutique.* The steps that one takes to pave the way for the realisation of something are *préparatifs.* Thus we may say, *Faire les préparatifs de départ ou de la guerre.*

Quart and *quartier* form another pair which may easily be misused. The former, from the Latin *quartus*, "fourth," is used in the sense of the "fourth part" of a thing. For example, *J'ai passé un mauvais quart d'heure; le quart d'heure de Rabelais*—that is, "the time for paying," in allusion to an adventure of Rabelais. We are familiar with this use of it in our word "quart" for the fourth part of a gallon. In a

nautical sense *l'officier de quart* means the "officer of the watch." *Quartier* means a division of a town, a "locality." Thus, *Demeurer dans un quartier insalubre.* In *donner quartier aux prisonniers de guerre* the word is used in a sense we are familiar with, and which we have adopted from the French.

Rage does not usually now signify excess of temper. Such an idea would be expressed in French by *fureur*. *Rage* is derived from the Latin word *rabies*, "madness," and is generally applied to canine madness or *rabies*. An old proverb says: "*Qui veut noyer son chien l'accuse de la rage.*" It is also used to express violent pain. *Avoir une rage de dent* is "to have a raging toothache."

Redingote is a corruption of our word "riding-coat." This word was borrowed from us in the eighteenth century at a time when it was the fashion among the upper classes in France to imitate English customs. A writer of the time says: "*Il se mit en redingote, habillement qui vient des Anglais et qui est ici très commun à présent.*" Originally it meant a "frock coat," but is now applied to any morning coat.

Regard is not "regard" for any one. This word would be translated into French by *égards*. *Regard* means a "look" or "glance."

Ressort means commonly "a spring," as a carriage-spring or watch-spring. It is also used in the sense of an appeal to a higher court. Thus Montesquieu says: "*Le parlement juge en dernier ressort*"—that is, "it is the final court of appeal." The word is further used in the legal sense of the extent of the jurisdiction of a court. Thus, *Cette affaire est du ressort du tribunal.* In our sense of the term "to resort" would be generally *fréquenter* (*un lieu ou une personne*), and the action of resorting would be *fréquentation*.

Rive is not "river," but "bank" of a river. The word for "river" would be *rivière* or *fleuve*.

Romance is not a "novel," but a "ballad" or sentimental song. *Romance sans paroles* is a "song without words." The word for "novel" is *roman*.

Salon is a word of the same Italian origin as our word "saloon"—that is, a "large room," but is not used in the sense we give to the word. It means a "drawing-room." *Le Salon* is the French equivalent for our Royal Academy exhibition of pictures and sculpture. *Fréquenter les salons* means to be a constant visitor in well-known houses.

Salle is a room in a house. Its purpose may be indicated by coupling to it a noun by *à* or *de*, as *salle à manger* or *salle de billard*. A bedroom is, however, always *une chambre*. *Salle* is used in several other connections, as *la salle d'audience d'un tribunal; une salle d'armes*, a "fencing-school."

Salut is not merely a "salute," but has moreover the theological signification of "salvation." Thus, *travailler à son salut* is to devote one's whole thoughts and energies to escaping punishment after death. *Salut* is also the name for the service in the Roman Catholic Church in which the sacrament is raised for the adoration of the faithful. *L'armée du salut* is not unknown in France.

Serment is not "sermon," but "oath." It is derived from the Latin word *sacramentum*, which has the same meaning. "Sermon" is in French *sermon*, except it means a funeral sermon, when it is *une oraison funèbre*.

N.B.—We have not translated the sentences used as illustrations. If any of the sentences present difficulties, write to "EDITOR, *Practical Teacher*," enclosing the coupon of the current number, and marking your envelope outside, "Modern Language Section." *A stamped addressed envelope must be sent for reply.*

ON FRENCH VERSIFICATION.

III.

TO an Englishman who makes only a superficial study of French verse, the structure of it seems to be too mechanical, and the rules which govern it arbitrary in their character. Such a conclusion as this would be unjust; but it is nevertheless true that for many years the great authority of Boileau was accepted in too unquestioning a spirit, and the free and natural march of French verse suffered from his *dicta* on *enjambement* and *hiatus* being too religiously observed. Among the first to set Boileau's authority on the *enjambement* at naught was André Chénier, who fell under the knife of the guillotine in the Revolutionary period. With the nineteenth century began the rise of Romanticism in France and in our own country. Walter Scott was our most brilliant product of this period, of which in France Châteaubriand and Victor Hugo were the chief apostles. As the Revolution had shattered the principle of authority in its application to government and to religion, so did the Romantic movement refuse to recognise its application in the domain of literature. The bitterness of the struggle between the Romanticists and the Classicists cannot be comprehended unless we realise that, paradoxical as it may seem, the French mind, which conceived and carried out the most revolutionary experiments in government, has almost an innate leaning to and reverence for antiquity and authority in matters of literature. But we must explain what is meant by *enjambement* and *hiatus*.

Enjambement means that a phrase which is commenced in one line of poetry is completed in the next.

Boileau, in his *Art Poétique*, forbade this under all circumstances.

"*Que toujours, dans vos vers, le sens, coupant les mots,*
Suspende l'hémistiche, en marque le repos."

This couplet not only enjoined the observance of the *cæsura*, but also interdicted *enjambement*.

While the enforcement of this rule added to the harmony and smoothness of the verse, it deprived it of strength, freedom, and naturalness. Both during and before Boileau's time the rule he laid down was not universally followed. Thus we find in Corneille,—

"*Avant qu'en ces alarmes*
J'eusse pu donner ordre à repousser leurs armes."

And Racine says:—

"*Mais ce qu'il n'eût point fait, la Guèce avec douleur*
Vous voit du sang troyen relever le malheur."

Boileau's great authority secured for the rule he laid down the assent of most of the poets of his century. André Chénier was the first poet of any note to declare war on this and other restrictions laid down by the classical writers of the seventeenth and eighteenth centuries, and the Romantic movement of the following century completed and carried to a triumphant issue the work he had commenced. Thus Victor Hugo makes Richelieu say:—

"*Je vois avec douleur que mon maître et mon roi*
Prête à mes ennemis plus de crédit qu'à moi."

And among numberless other instances we could quote, we find in Alfred de Vigny:—

"*Hélas! dans votre église*
Je suis entré, mais pour n'en plus sortir."

Hiatus is the name given to one vowel sound immediately following another. There is always a tendency to run the two vowels into one sound, and it is only by deliberate and careful articulation that we can overcome this tendency. The old classical writers strictly forbade two kinds of *hiatus*.

1. When a sounded vowel at the end of a word clashed with one at the beginning of the next word, as, *Il est sorti à une heure.*

2. When a word ended in the combination of an accented vowel, and either an *e* mute, which could not be elided, or one of the silent endings *es*, *ent*, as, *La vie nous est chère; ils se soustraient à mes regards.*

These rules were not, however, generally accepted by the poets before the time of Boileau, who embodied it in the oft-quoted lines,—

"*Gardez qu'une voyelle, à courir trop hâtée,*
Ne soit d'une voyelle en son chemin heurtée."

We shall continue this subject in a future number.

FRENCH PRIZE COMPETITION.

RULES.

1. All translations should be **posted not later than January 8**, and addressed:—PRIZE EDITOR, Office of the *Practical Teacher*, 35 and 36 Paternoster Row, London, E.C.
2. Competitors should cut out and send the Coupon which appears on the Back Wrapper page of the current number.

ALTERATION IN RULE 3.

3. Competitors should write pseudonym only on MS. Prize-winner will be asked to send name and address for publication.
4. No competitor may take the prize offered more than once in three months.

A Prize of Half a Guinea is offered for the best rendering into English of the following extract:—

On consultait un homme qui avait quelque connaissance du cœur humain sur une tragédie qu'on devait représenter; il répondit qu'il y avait tant d'esprit dans cette pièce qu'il doutait de son succès. Quoi! dira-t-on, est-ce là un défaut dans un temps où tout le monde veut avoir de l'esprit, où l'on n'écrit que pour montrer qu'on en a, où le public applaudit même aux pensées les plus fausses quand elles sont brillantes? Oui, sans doute, on applaudira le premier jour, et on s'ennuiera le second. Ce qu'on appelle esprit est tantôt une comparaison nouvelle, tantôt une allusion fine; ici l'abus d'un mot qu'on présente dans un sens, et qu'on laisse entendre dans un autre; là un rapport délicat entre deux idées peu communes; c'est une métaphore singulière; c'est une recherche de ce qu'un objet ne présente pas d'abord, mais de ce qui est en effet dans lui; c'est l'art ou de réunir deux choses éloignées, ou de diviser deux choses qui paraissent se joindre, ou de les opposer l'une à l'autre; c'est celui de ne dire qu'à moitié sa pensée pour la laisser diviner. Enfin, je vous parlerais de toutes les différentes façons de montrer de l'esprit, si j'en avais davantage; mais tous ces brillants (et je ne parle pas des faux brillants) ne conviennent point ou conviennent fort rarement à un ouvrage sérieux et qui doit intéresser. La raison en est qu'alors c'est l'auteur qui paraît, et que le public ne veut voir que le héros. VOLTAIRE.

RESULT OF THE DECEMBER COMPETITION.

The prize is awarded to "Fittick." Will "Fittick" kindly send name and address for publication?

First Class.—Lil, Colet, C.E.M., Caper, Matley, ——, La Printanière, Amry, Agaznog, Kettering, Arethusa, Ceylon, Mrs. Malaprop, Traduzco, Compton, C.A.B., Stylo, Dafydd ab Iago, Trudge, Clip, Pourquoi? Veronica, The Choctaw, Festina Lente, Sorley Dox, Strange, Day Dawn, Kelso, Hermia, Matilda, Ecossaise, Ethik, Rus, Elgin, A. F. Bee, Adlitam, Nemo, ——, E.W., Campagna, Damaris, Forth, W 5906, Little Mitey, Bam, St. Clair, R.N., L'hiver, Rural, Garrghesta, Automobile, Fiscal, Welburn, Guillaume.

Second Class.—Aim, Elsie, Portignon, Hyacinth, Me, White Rose, Etranger, Hélène, Hussar, Salusbury Road, Grimbarian, Janet, Enderbian, Etruria, Thomasina, Croissant, Rex, Jean, Yum.

Received too late for classification—Try Again, Nothing Venture, Christmas, Lotys, Rural.

Two papers were sent in without pseudonyms written on them.

Report.

There is a striking difference in general merit between this month's and last month's papers. Very few are really bad, and the first dozen or so were so good that it was difficult to select the one most deserving of the prize. *Gracieux*, as was natural, led some translators into error, to whom, however, the phrase *gracieuse mélancolie* might have given pause. A study of the series of papers now appearing on "Difficulties of French Idioms and Constructions" will deal with stumbling-blocks of this nature, as well as with others which may mislead English readers. The impersonal use of *il* in *il y entre* proved also a difficulty to some. A few took *entre* as a preposition. Several students need to be reminded that *L'amie plus âgée* does not mean quite the same thing as "The elderly friend." "Elderly" has an absolute meaning, whilst "elder" is relative in its application. Several went wrong over *un déchirement de l'une et de l'autre part.* Some rendered it as "a tearing of one part from another," whilst in one case it was put "without rending soul from body."

Prize Translation.

She had vowed to her that sort of friendship in which young girls indulge—a very powerful and delicate feeling, which, by the tenderness of its tone, resembles the devotion of an elder sister to a younger one. A somewhat unconsciously protective feeling enters into it, as well as a certain leaven of romantic and becoming melancholy. The elder of the friends is severe and chiding. She attempts to restrain, even while enjoying them, the excessive enthusiasms of the younger one, whose confidences she receives and even invites with the touching seriousness of a counsellor whose own lack of experience stands in great need of counsel. The younger friend is curious and admiring. She reveals herself in all the candour of that graceful awakening of thoughts and emotions which accompany the years of budding womanhood. And when, as was the case with Alba Steno, there is a certain want of sympathy between the younger friend and her mother, the feeling for the sister of her adoption becomes so profound that the association cannot be broken without a frightful wrench on both sides. That is why, on quitting Rome, the faithful and noble Maud experienced a feeling of relief as well as a feeling of pain—of relief, because she would not be called upon to have an explanation with Alba; of pain, because it was so bitter to feel that she should never be able to justify her conduct to her friend, nor even again to help her to disentangle herself from the difficulties of her life; in short, that she could never hope to love Alba openly, as she loved her secretly. FITTICK.

LETTRE D'EXCUSES.

A Mme. Goncegru, née Rousseau.

11 Juillet 1754.

IL y a quinze jours, ma très bonne et très chère tante, que je me propose, chaque matin, de partir pour aller vous voir, vous embrasser et mettre à vos pieds un neveu qui se souvient avec la plus tendre reconnaissance des soins que vous avez pris de lui dans son enfance et de l'amitié que vous lui avez toujours témoignée. Des soins indispensables m'ont empêché jusqu'ici de suivre le penchant de mon cœur et me retiendront encore quelques jours; mais rien ne m'empêchera de satisfaire mon empressement à cet égard le plus tôt qu'il me sera possible; et j'aime encore mieux un retard qui me laissera le loisir de passer quelque temps auprès de vous, que d'être obligé d'aller et de revenir le même jour. Je ne puis vous dire quelle fête je me fais de vous revoir, et de retrouver en vous cette bonne et chère tante, que je pouvais appeler ma mère par les bontés qu'elle avait pour moi et à laquelle je ne pense jamais sans un véritable attendrissement.

Je vous prie de communiquer à M. Goncegru le plaisir que j'aurai aussi de le revoir, et d'être reçu de lui avec un peu de la même bonté que vous avez toujours eue pour moi. Je vous embrasse de tout mon cœur l'un et l'autre et suis avec le plus tendre et le plus respectueux attachement, etc.

J. J. ROUSSEAU.

LES FRANCS.—Les Francs relevaient et rattachaient sur le sommet du front leurs cheveux d'un blond roux, qui formaient une espèce d'aigrette et retombaient par derrière en queue de cheval. Leur visage était entièrement rasé, à l'exception de deux longues moustaches qui leur tombaient de chaque côté de la bouche. Ils portaient des habits de toile serrés au corps et sur les membres, avec un large ceinturon auquel pendait l'épée. Leur arme favorite était une hache à un ou deux tranchants, dont le fer était épais et acéré et le manche très court. Ils commençaient le combat en lançant de loin cette hache, soit au visage, soit contre le bouclier de l'ennemi, et rarement ils manquaient d'atteindre l'endroit précis où ils voulaient frapper. AUGUSTIN THIERRY.

OUR TUTORIAL SECTION

OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

Late Principal of the Belvedere Pupil Teachers' Centre, First on Scholarship List; Author of "Scholarship School Management," "Building of the British Empire," etc.

NEW SCHOLARSHIP COURSE FOR DECEMBER 1904.

First Month—January.

IN commencing a new course it will probably be helpful if a few remarks on the syllabus and suitable text-books are given. The syllabus *in extenso* may be obtained, post free, on application to the Secretary, Board of Education, Whitehall, S.W.

1. *Reading.*—"To read with clear enunciation, ease, and intelligence from a work of a standard prose author and of a standard poet." *Failure in this subject will entail failure in the whole examination.*

All candidates would do well to read the circular issued some time since on this subject by the Board of Education, and lay it well to heart. The mere repetition of words in due order does not constitute "reading." Unless the reader can grasp the meaning fully, and express it by proper modulation and emphasis, enunciate clearly and easily, very few marks will be obtained. Again, it is very necessary to distinguish between silent reading and oral reading. The latter involves a certain amount of muscular action of the tongue, lips, throat, and lungs, which the former does not, and these muscles require just as careful training as the muscles of the fingers do for piano or violin playing. It may seem superfluous to point this out, but long experience shows that reading is systematically neglected, on the supposition that it will be all right.

Candidates will naturally offer for reading one of the special books in English. In addition to these, every one should read as widely as possible. I shall be pleased to send a list of books that may be read with profit to any one on receipt of a stamped addressed envelope.

2. *Repetition.*—The same remarks apply to this subject as to reading. Oral practice is essential. Candidates will find no difficulty in selecting passages from the play, although there are many other poems which might with more utility be committed to memory.

Again, the syllabus sets the *minimum*. No earnest student would think of limiting the amount of poetry learned in a year to one hundred lines. There are dozens of short poems, extracts, etc., which are continually met with, and which amply repay the trouble of making them one's own.

3. *Teaching.*—In addition to the practical examination in school, the "candidates will be required to answer questions on the method of teaching of any subject, whether to older children or infants."

This again must not be left to chance, but requires systematic study. The text-book recommended is *Scholarship School Management* (Messrs. T. Nelson and Sons), specially compiled for this examination.

4. *Drawing—Freehand.*—Candidates are required to make a drawing in outline with pencil, brush, or pen on a *half imperial sheet* of paper, from photographs or diagrams of ornament, foliage, fruit, etc., in different materials—for example, stone, wood, metal, textiles, etc.

The chief points to notice are (1) that the drawing has to be a fairly large size (half imperial = 15" by 22"); and (2) that the best effect is produced by using a brush and sepia. Use a red sable medium brush and water-colour sepia. Much softer, smoother lines can be obtained with a brush, and much more expression given. It is by far the easiest method. A pen drawing is usually hard and harsh. The student should practise drawing from the natural objects themselves. There is no lack of good copies published by Messrs. Nelson and Sons, Chapman and Hall, The Fine Art Company (Derby), etc. One or two copies should be done each week, and submitted for criticism, if the student is away from help.

5. *Music.*—The syllabus is practically the same as last year, and goes very little beyond what has been done during apprenticeship. A knowledge of *both* notations is necessary. Students will find all they require in Nelson's *Music for Pupil Teachers*, which contains both notations and numerous exercises.

For the practical examination, *Practical Music for Pupil Teachers* (Curwen) should be used regularly.

Every student should obtain full marks in music. There is very little to do, but it is often neglected.

Every one should work for the School Music Teacher's Certificate, particulars of which can be obtained from the Tonic Sol-fa College. This covers all the ground for scholarship, and is besides a valuable addition to one's qualifications in seeking appointment.

6. *Needlework.*—The preparation for this subject is comparatively easy. Many firms publish diagrams of the various articles. *Needlework and Cutting Out*, by Miss Rosevear, is a good book to have for reference.

7. *Penmanship—To set copies in large and small hand.*—This is another of those "little" subjects which are left to chance. "Defective spelling or handwriting may be taken into account in estimating the value of a candidate's work," is a preliminary note to the whole syllabus, caused, no doubt, by the wretched papers which are often submitted.

Good writing is easily acquired. A few minutes' daily practice from a good model and continual care are, of course, needed. Every one should find a pen that suits, and use no other. Get a sample box of Brandauer's pens, and you will find something suitable. Good ink and paper are equally essential.

The text-book recommended is the *Practical Teacher Copy Book*, specially written for pupil teachers, containing all the practice needed for a year.

8. *Writing from Dictation.*—The passages set are very easy. If any spelling book is needed, I would recommend *One Thousand Words Commonly Misspelt*, price 1d., series A, B, and C. All the common difficulties are dealt with. Occasional tests are, of course, needed.

9. *English Composition.*—Steady preparation in this subject is needed. I am often asked the question, "How can I write a good essay?" The answer is obvious. The power depends upon two things—(*a*) a sufficient knowledge of the subject set; and (*b*) a sufficient vocabulary and flow of expression to clothe the ideas with words. The first is obtained by wide reading and careful thought, and the second by care and familiarity with good models. One's phraseology depends upon one's general reading. A child who lives in the slums cannot talk good English, because it is never heard. A student who reads rubbish will inevitably write rubbish. Many books have been written on this topic, but although they contain excellent advice, real progress can only be made by the channels indicated. One no more writes a good essay from reading "how" to do it than one learns to swim or cycle from being told "how."

Systematic practice, careful and exact thought, familiarity with good writers, will produce a good style. There is no royal and easy road to success.

10. *English.*—The parsing and analysis should be fairly easy now. The etymology and general outline of the history of the English language is dealt with in the *Pupil Teacher's English Notebook*. When that has been mastered, additional material will be found in the special books, and in a more extensive history of the language.

A good grammar is essential. Nesfield's *English Grammar* is perhaps about the best, but Meiklejohn's, Daniel's, Mason's, or any standard work will suffice.

The special books are Shakespeare's *Much Ado about Nothing*, and eight of Bacon's *Essays*.

There are many special editions of these books. We can confidently recommend *Much Ado About Nothing*, edited by Page, published by E. J. Arnold and Son, also Macmillan's edition, and the Pitt Press.

Macmillan and. Co have also issued the *Essays*, and so have Messrs. George Bell and Sons. The latter is a very capable and useful book for students.

For general reading—*David Copperfield, Lay of the Last Minstrel*, and *Kenilworth*. Any edition will do for these; there is little to annotate. *David Copperfield* is issued in Nelson's "New Century Library," as is also *Kenilworth*.

11. *Geography.*—There is no change in the work set. Good text-books are essential. Meiklejohn's will do for general geography. Gill's *Colonies* is an excellent production, with Meiklejohn's *Handbook* as a preliminary survey. A good atlas is essential, and a text-book on commercial geography will be found most useful.

A candidate is expected to take an intelligent interest in the work, and not to trust merely to lists of names. For the history of the Colonies, Meiklejohn's *Building of the British Empire* is recommended.

In addition to the text-book, all students should read works of travel and exploration, and keep themselves up to date by the newspaper

12. *History.*—Meiklejohn's *History of England* is recommended, with some analysis of history as a guide; but any good text-book will do. Scholarship candidates are expected to show a deeper knowledge of the cause and effect of events, gradual growth or decay of institutions, etc., than a pupil teacher.

13. *Arithmetic.*—There is practically only one book which is pre-eminently suited for the examination—namely, Christian and Collar's *New Arithmetic* (A. M. Holden). Written by practical teachers for teachers. it is excellent in grading, arrangement, theory, and exercises.

14. *Algebra.*—Hall and Knight (Macmillan) should be used.

15. *Euclid.*—Hall and Stevens (Macmillan) or any good text-book will do. Egan's *Exercises* will supply all that is wanted in the way of deductions.

16. *Language.*—Most students will probably take French, and they will find the papers now appearing in the *Practical Teacher* of great benefit. It is impossible in this course to set anything which will help all. I will gladly advise any individual student who cares to apply for assistance. It is useless taking up a language unless some real progress is to be made.

17. *Elementary Science.*—Nearly all students will have a text-book on Section I. of this. In Section II. there is a choice between chemistry, astronomy, and biology. If it is possible to attend any class, the chemistry should be taken; it will be far more useful in after years. The lonely student need not think it an impossibility to master this subject by himself, but I can advise the individual more advantageously than is possible in a general survey like this.

18. *General Information.*—This is a subject on which it is impossible to write a text-book. It is included in the Scholarship Examination, as a means of testing the student's habits of careful and exact observation, and as a slight corrective to the narrow-mindedness which, unfortunately, is so often displayed.

There are several very good books of questions issued—namely, Cooke's *Test Papers in Intelligence* (Macmillan); *General Knowledge Test Papers*, by J. Treble (Arnold and Son). A key is published to each of these. The questions indicate the style of question which may be expected, and must not be considered as a text-book. The student will do best in this subject who has read wisely and not allowed anything to pass by unknown. One need not be discouraged because questions continually occur to which the answer is not known. There are few men living who could answer all the questions set even in the two books mentioned. To be, like the Athenians, continually learning some new thing is the mental habit which has to be cultivated.

Methods of Study.

A few words are necessary on this topic, not so much to those who attend centres as to the student working away from any assistance. Success depends upon regularity and persistence of effort. Spasmodic efforts now and again are useless, and never produce a high position. It is the careful, plodding student who succeeds. One of our most learned men used to say that as a student he read about as many pages as his companions did books, and yet he was always top in examinations. When he had finished a page, he *knew* it; when others had finished a book, they had a hazy, superficial knowledge, lacking in exactitude and depth.

Prepare a time-table to include *all* the subjects, giving a due proportion of time to each subject; and having found it to work satisfactorily, adhere to it rigidly. Neither let work accumulate nor endeavour to do too much. The latter is as dangerous as the former.

The work in each subject should be divided into about forty portions, one of which must be thoroughly mastered each week. With a definite syllabus this is comparatively easy, and this we do in the course. Test your work by written exercises, such as those given from month to month. There is an art in writing a good answer.

Space forbids any further advice, but I shall always be pleased to assist any student who is in a difficulty, if he or she will take the trouble to write to me.

Work for the Month.

1. *Reading and Repetition.*—At least ten minutes' practice per day.

2. *Teaching.*—Chap. i., *Scholarship School Management.*

This will be found "dry" to the easy-going, but dealing as it does with the elements of psychology, which influence every lesson, it is of the very highest importance, and should be carefully studied, and re-read if necessary every month.

3. *Drawing.*—One or two copies each week. These should be submitted for criticism in the absence of any competent teacher.

4. *Music.*—Staff-notation, major and minor scales, and signatures. The mnemonic "GooD AlE and BeeF" gives the scales in order. Reading the capitals forward we get the sharps—G, D, A, E, B, F♯; backwards the flats—F, B♭, E♭, A♭, D♭, G♭.

5. *Penmanship.*—Ten minutes' practice per day.

6. *Composition.*—One or two essays each week on such subjects as—

(*a*) My Favourite Book.
(*b*) Newspapers.
(*c*) The Different Characters of Children.
(*d*) "A bird in the hand is worth two in the bush"
(*e*) The English Character.
(*f*) The Government of England.
(*g*) Christmas.

Read up the subject if necessary, and write out an analysis of your ideas under various heads, in order to prevent useless repetition. For example take (*e*) The English Character. Read, if you can, what Emerson says about it in his *Essays*. Compare the English with other nations—more steady and persevering than the Latin races; more adaptable than the Germanic; more energetic than the inhabitant of Arctic or Equatorial districts; good seamen; fond of liberty, and of drink; the only successful colonisers. Then trace the causes. One is climatic environment—neither stunting nor enervating, but stimulating; the other is racial—to the stolid phlegmatic Saxon, fond of freedom, debate, and drink, is added the love of the sea by means of the Norse element, added by the Danish invasion. To this came the livelier, brighter, more artistic Norman French element, with the result that the Latin fickleness and exuberance is tempered by the Teutonic stolidity, and *vice versa*. It is not difficult to follow and prove this chain of thought.

7. *English.*

(*a*) Twenty-five roots and meanings per week.
(*b*) *Much Ado About Nothing*, Act I., Scene i., lines 1–202.
(*c*) The Essay on Truth.
(*d*) History of the language to 1066.

Note carefully the position of Anglo-Saxon in the Aryan family of languages, and what relation it bears to other European languages.

8. *Geography.*—(*a*) British possessions in Europe and Asia (excluding India).

(*b*) Revise Europe generally, and France, Spain, and Portugal in detail.

In dealing with the Colonies pay especially attention to their trade, means of communication with England, their use and government.

9. *History.*—From the Roman invasion to 1066.

10. *Arithmetic.*—Revise up to and including G.C.M. and L.C.M. Make sure that you can work all the sums set in the text-book, and work Nos. 1–100 of the general examples.

11. *Algebra.*—Factors. These require very thorough and careful study.

12. *Euclid.*—Revise Book I. Definitions, axioms, and postulates. Props. 1–10, with six deductions per week.

13. *Elementary Science.*—Prepare the first two sections of the syllabus.

14. *General Information.*—Look up from a good dictionary the meaning of common abbreviations, commonly used French and Latin phrases.

Test Questions in General Information.

1. Give examples of migration of birds and animals, and explain the causes.

2. Write down the ten best books you have read, and say approximately when the authors lived.

3. Fill up blanks in the following :—
(*a*) ..... is human ..... divine.
(*b*) ..... is the better part of .....
(*c*) 'Tis ..... lends enchantment to the .....
(*d*) The ..... lead but to the .....
(*e*) None but the ..... deserve the .....
(*f*) The ..... that cheers but not .....
4. Explain simply how a steam-engine works.
5. Why is a volcano sometimes in eruption and sometimes not ?
6. Write a short life of any woman noted in English history.
7. What is meant by crossing a cheque ? What is the use of it ?
8. What is meant by the Cabinet ? Who are the chief members at the present time ?

Result of Last Year's Competition.

Over a hundred and fifty students took part in this competition, the majority answering most of the papers.

The highest percentage of marks was reached by Mr. E. G. Peal, St. Peter's Schools, Marlborough. Close behind him come Miss Cowan, Miss Alice Hanson, Miss K. Gillingham, Miss Doreen Spencer, Miss Annie Keating, Miss M. Pilbeam, Miss M. Hodgkisson.

PUPIL TEACHERS' COURSE.

For Candidates' Examination, 1904.

1. *Reading, Repetition, and Penmanship.*—Ten minutes' practice daily.

2. The *Ode on Spring.*—First half.

3. *Arithmetic.*—Application of decimals to weights and measures. A very common mistake is made in reducing every decimal to a fraction before applying it to money, etc. For example, find the value of ·6125 of £5. This should not be done by turning the ·6125 into a fraction, but by reduction.

$$\begin{array}{r} \cdot 6125 \\ 5 \\ \hline 3\cdot 0625 \\ 20 \\ \hline 1\cdot 2500 \\ 12 \\ \hline 3\cdot 0000 \end{array} \qquad \text{Ans. £3, 1s. 3d.}$$

This cannot always be done, but it can in many cases. Note the following :—

Reduce £3, 17s. 10½d. to the decimal of £1, by practice.

		3·	= value of	£3	0	0.
10s. of £1 is	½	·5	= ,,	0	10	0.
5s. of 10s. is	½	·25	= ,,	0	5	0.
2s. 6d. of 5s. is	½	·125	= ,,	0	2	6.
3d. of 2s. 6d. is	1/10	·0125	= ,,	0	0	3.
1½d. of 3d. is	½	·00625	= ,,	0	0	1½.
		3·89375	=	£3	17	10½.

4. *Geography.*—The general features of Europe. Draw a sketch-map. Enter all details (capes, bays, rivers, mountains, etc.) to be learned, and go over thoroughly till known.

5. *History.*—William and Mary and Anne.

Note the great changes arising out of the Revolution, as expressed in the Bill of Rights. The disputes of the last two hundred years abolished. House of Commons supreme. Growth of government by party.

Chief points :—Reduction of Scotland and Ireland. War with France; why? Toleration Act, Mutiny Act, Triennial Bill.

Anne. War of Spanish Succession (learn causes). Marlborough's victories and their results. Treaty of Utrecht. Union with Scotland (learn chief terms). Dr. Sacheverell.

6. *Elementary Science.*—Revise the first three chapters.

Test Questions.

1. Analyse the following, and parse words in italics :—

> "*No further* seek his merits to disclose,
> Or *draw* his frailties from their dread abode
> (*There* they *alike* in trembling hope repose)—
> The *bosom* of his Father and his God."

2. Make abstract nouns from the following by adding a suffix :—Long, still, merry, wise, handy, steal.

3. Write notes on Bog of Allan, Giants' Causeway, Connemara, Queenstown, Valentia.

4. Describe, with a sketch-map, the basin of the Shannon.

5. Describe the Great Plague or the Great Fire.

6. What led to the trial of the Seven Bishops, and what did the trial lead to ?

7. Draw a diagram, and explain the action, of a common pump. What is the greatest depth from which a pump will lift water ?

8. Work the following :—

(1.) Show in what sense $\cdot\dot{9} = 1$.

(2.) Find the value of $\dfrac{\cdot\dot{1}42857\dot{1} + \cdot 28571\dot{4}}{\cdot\dot{7}14285 - \cdot 571428}$ of 1 guinea.

(3.) What fraction is equal to $\cdot 3\dot{1}42857\dot{1}$?

(4.) Divide ·12$\dot{3}\dot{4}$ by 6·12 to three places of decimals.

(5.) Reduce in the shortest way you can $\frac{1}{13}$ to a recurring decimal.

First Year.

1. *Reading and Repetition.*—Regular oral practice in these subjects must be taken.

2. *Penmanship.*—Ten minutes' daily practice in the *Practical Teacher's Copy Book.*

3. *English.*—Cowper's *Expostulation*, lines 258–281; or Cowper's *The Task*, Book V., lines 260–282.

Paraphrase and analyse the whole, and parse any words presenting difficulty. Learn derivations of all important words. Twenty-five roots and their meanings should be learnt each week.

4. *History.*—Elizabeth.

This reign is of the greatest importance, and requires the most careful study. Note the differences between the commencement and end of the time. When Elizabeth succeeded there was no army, no navy, a debased coinage, little trade and commerce, hostility of France, Spain and the Pope, a bitter religious hostility at home, and a continual danger from Mary Queen of Scots. At the end there were plenty of men trained to fight (though no standing army), a powerful merchant navy, a new coinage, France was friendly, Spain and the Pope utterly beaten, religious parties in England were on much better terms, trade and commerce had increased greatly, and there was no fear from Scotland. These changes were brought about by careful statesmanship on the part of the queen and Cecil. When France became threatening, the Huguenots were helped; when Spain was ready to attack, the revolt in the Netherlands was fomented, and attacks made on the Spanish Main. Judicious toleration pacified the Catholics, weavers from the Netherlands were housed and welcomed, and the keen interest taken by Elizabeth in commerce developed it enormously. Study each event in the reign in this connection.

5. *Geography.*—Asia Minor, Arabia, Persia, Afghanistan. Draw maps for each abundantly. Pay special attention to towns, productions, imports, and exports.

6. *Arithmetic.*—Continue exercises in percentages.

7. *Science.*—Revise Light.

8. *Euclid.*—Props. 27, 28, with four deductions per week.

9. *Algebra.*—Harder fractions.

Test Questions.

1. Write as specimens of copy setting—
Large hand—*Advantageous.*
Small hand—*He is a freeman whom the truth makes free.*

2. Write a short essay on Winter.

3. Say what you can about China under these heads—(1) Population, (2) extent, (3) productions, imports and exports, (4) treaty ports.

4. Point out in what ways Japan has developed during recent years.

5. Give an account of the Marian persecution.

6. Write a life of Protector Somerset.

7. Work the following :—

(1.) How much per cent. will be added to a person's net income by a reduction in the income tax from 10d. to 6d. in the £1 ?
Ans. 1⅔.

(2.) A cask which holds 20 gallons is filled with 15 gallons of brandy and 5 of water. 4 gallons of the mixture is drawn off, and the cask is again filled with water. Find the percentage of brandy in the second mixture. Ans. 60.

(3.) A man added 20 per cent. to his capital each year, and in four years it amounted to £5184. What was his capital at first ?
Ans. £2500.

(4.) A woman bought a certain number of eggs at the rate of four for 3d., and sold them at five for 4d., by which she made a profit of 2s. How many eggs did she buy ?

8. A jug of hot water is placed on a table. Explain carefully in what ways it loses its heat.

Second Year.

1. *Reading and Penmanship.*—Regular daily practice.
2. *Geography.*—New Zealand.
3. *History.*—Revise any weak part.
4. *English.*—Milton's *Paradise Lost*, Book III., lines 644 to the end. The notes in the text-book will explain all difficulties.
5. *Arithmetic.*—Problems on clocks and trains.

Test Examination.

History.

(One hour. Answer *three* questions.)

1. What were the good and bad points in the character of Charles the First?
2. How was the War of the Spanish Succession brought about? What part did England take in it?
3. What attempts were made by the Stuarts to regain the throne of England? Why did these attempts fail?
4. Write a brief account of any three of the following:—Hampden, Clarendon, Clive, Wilkes, Nelson, Canning.
5. Mention any events connected with the following:—Naseby, Dunbar, Sedgemoor, Killiecrankie, Blenheim, Bunker's Hill, Camperdown, Tilsit, Sebastopol.

Arithmetic.

(One hour. Answer *three* questions.)

1. Two numbers are in the ratio of 24 and 30, and their L.C.M. is 720. What are the numbers?
2. How can you make clear that "0" at the end of a decimal has no significance? How many 10's are multiplied together to form the denominator of a decimal?

Find the value, correct to two places of decimals, of—

(1) $\cdot 637 \times \cdot 842$.

(2) $1 + \frac{1}{1 \times 2} + \frac{1}{1 \times 2 \times 3} + \frac{1}{1 \times 2 \times 3 \times 4}$, etc.

3. If I sell books at 3s. 6d. a dozen I make 10 per cent. more profit than if I sell them at 5s. 6d. a score. What is the cost price of each?
4. A cubic foot of paint is sufficient to cover two-thirds of the walls of a room 21 feet long, 15 feet broad, and 12 feet high, to a uniform thickness. Find the thickness of the paint.
5. Find the price in French money of 3149·6 metres of cloth at 6·75 francs per metre. Reduce the quantities to English measure and value, and find the cost in English money. (1 metre = 39·37 inches; 25 francs = £1.)

Science.

(Three-quarters of an hour. Answer *three* questions.)

1. How would you exhibit to a class the action of sodium on water? What substances are produced when this action takes place?
2. Some kinds of flames give rise to much and others to little light. How do you account for this? Give examples of each sort.
3. How is lime obtained? What results when water is poured on lime? What is lime water?
4. An unmagnetised iron bar is laid upon the table. Draw a diagram to show how it becomes magnetised when it is taken up by the two poles of a horse-shoe magnet.
5. A dipping needle is mounted in the usual way. How will it behave (1) when its axis is placed in a magnetic east and west line; (2) when placed in a magnetic north and south line?

Music.

(Fifteen minutes. Answer *three* questions.)

1. Select from the following notes pairs of notes to illustrate the intervals named:—**d m s se ta.**

(1.) Augmented fifth.
(2.) Diminished fifth.
(3.) Two minor thirds.
(4.) Two major thirds.

2. What would that note which is **lah** in the key of C be in the following keys:—B♭, E♭, B, E, D, F?
3. Write in figures over each note and rest of the following passage its value in pulses and fraction of a pulse:—

| : :m,r | d :-.m : l | s :-.m,f : s,l,t | d' : l : m.,fe | s : - : m |

| f : -.s : l . t | d' : s.,f : m.s | l : - : t, | d : - : ‖

OUR CERTIFICATE COURSE FOR 1904.

BY GEORGE COLLAR, B.A., B.SC.,
Head-master of the Stockwell Pupil Teachers' School.

TEST QUESTIONS ON LAST MONTH'S WORK.

Theory of Teaching.

1. When and how far is it desirable to refer to the Latin or Greek derivation of a word in teaching children? Say what kind of previous knowledge should be possessed by them before such reference is made; and give examples of some words the meaning of which is made clearer by their etymology, and of others in which that meaning is obscured by it.
2. Give the substance of Froebel's remarks on the way to deal with children's questions.

English Language and Literature.

1. Discuss the historical inaccuracies which occur in the fifth act of *Henry V.*
2. Explain the following words and phrases:—*Which like a mighty whiffler 'fore the king seems to prepare his way. Bringing rebellion broached on his sword. Art thou bedlam? Even-pleached. While that the coulter rusts that should deracinate such savagery.*

English History.

1. Explain the rise of Spanish power under Charles the Fifth.
2. Trace the course of the quarrel between England and Spain in the reign of Queen Elizabeth.

Geography.

1. Give a short account of each of the following:—Wallace's line, Peshawar, the Pamirs, Port Arthur.
2. Give an outline of the physical geography of Japan.
3. Enumerate the different parts of Asia which are under the control of the respective European states.

Arithmetic.

1. A person left his property to five persons in the following proportions—$\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{7}$—and the residue to Guy's and St. Thomas's Hospitals in the ratio of 2 : 3. Guy's received £769, 4s.; what sum did he leave?
2. A runs 100 yards in 10 seconds, and beats B by 10 yards. If B had a start of 2 seconds, what would be the exact result of the race?
3. Explain clearly how you would give to children a first idea of ratio.
4. In the reprint of a book, consisting of 810 pages, 50 lines are contained in a page instead of 40, and 72 letters in a line instead of 60; of how many pages will the new edition consist?

Algebra.

Solve the equations:—

(*a*) $\sqrt{x^2 + ax} + \sqrt{ax + a^2} = x + a$.

(*b*) $\begin{cases} \frac{3}{8x} - \frac{7}{2y} = 1. \\ \frac{1}{6x} - \frac{11}{12y} = \frac{1}{4}. \end{cases}$

(*c*) $\begin{cases} x^2 - 3xy = 4. \\ y^2 + 5xy = 21. \end{cases}$

(*d*) $\frac{x - b}{x - 4b} + \frac{x + 2a}{4(a - b)} = 1.$

(*e*) $6\sqrt{\frac{x}{x+2}} - \sqrt{\frac{x+2}{x}} = 1.$

(*f*) $y(x + 5y) = 2x(7x - y) = 1.$

Euclid.

1. Construct a triangle, having given the base, the sum of the sides, and the vertical angle. Discuss any failing cases.
2. ABCD is a quadrilateral inscribed in a circle, and AB, DC produced to meet in O; show that the triangle AOC is equiangular to the triangle BOD.
3. BC is the common chord of two circles ABC, DBC, and E is any point in the chord. FEG is a chord of one circle, and HEL of the other. Show that FGHL lie on a circle.

Elementary Science.

1. In what respects do animals differ from plants, and how do both differ from minerals?

2. Describe the amœba, and say how it performs the functions regarded as necessary for animal life.

NOTES AND SYLLABUS FOR JANUARY.

English Composition.

Prepare essays on the following subjects:—

1. The influence and duties of the press.
2. Recent scientific discoveries.
3. Photography as a recreative amusement.
4. "Neither a borrower nor a lender be."
5. Vivisection.

Theory of Teaching.

Study the methods of teaching history in schools. Observe the advantages that follow from a study of history, and notice the conditions under which those various benefits are attainable. Be prepared to sketch a course of lessons suitable for a year's (or term's) work with a given class.

Read carefully the third section of the *Student's Froebel* on "The Boy."

In the childhood stage Froebel considers that the objects with which a child makes acquaintance are simple—that is, the child recognises neither the fact that each is built up of parts, nor that it is related to other objects to constitute a whole. Each object is also quite intimately associated with its name. As the man passes from childhood to boyhood he begins to regard language as something apart from the things it denotes, and it is in the boyhood stage that formal instruction begins. The *nursling* was purely receptive, developing simply under the protection and fostering care of its parents; the *child* was allowed to develop itself, and assisted in its endeavours to give natural expression to its feelings. "In the *boy* grow activity of intellect and will. To raise the activity of will into firmness, to mould and animate a pure, firm, enduring will so as to realise and practise genuine humanity, is the chief aim and final goal of the boy's training by school and instruction." The child's active impulses develop into the formative impulses of the boy, who is always anxious to help his parents and to share in their work. If this impulse is rudely repressed it will die away; hence the importance of accepting a boy's offer of help and directing it into a useful channel, or at least of treating the offer with kindness even if it cannot be accepted with convenience. "The healthy boy, simply brought up, never avoids or tries to escape an obstacle or difficulty; he looks for them, and he overcomes them." He gives vent to his natural desires by modelling mountains, rivers, castles, and walls; he has a desire to cultivate a garden of his own—although there are some boys in whom the horticultural instinct is certainly not a strong one. Froebel strongly recommends that boys should have a garden of their own, and should be encouraged to grow useful products. We should suggest also that the boy's taste for the beautiful should be developed by inducing him to cultivate a few flowers, lest he get hold of the idea that his whole efforts should be directed towards the production of objects which have a market value.

Froebel gives some valuable remarks on boys' games, and shows that in them each boy not only develops his physical strength, but also his mental and moral forces to an even greater extent when the games are associated or organised. Thus, in such a game a boy has an opportunity of showing "justice, moderation, self-control, truth, faithfulness, kindness, and strict impartiality too;" and we must remember that such qualities, like the physical forces, are developed and strengthened by exercise. In watching boys at play we find them displaying courage, endurance, resolution, and presence of mind; while in their dealings with the weak, or with those that are new to the game, they can show pity, patience, and encouragement. The bully among boys is quite an exceptional creature. So important does Froebel consider this as a training for future social life, that he lays it down as an important principle for municipal governors that "every town ought to have a special playground for its boy-world." We are glad to say that in England this is pretty generally recognised, not only by school authorities, but also by county and borough councils, who provide parks and open spaces and generally a gymnasium or boys' playground which has no connection with school.

Boys have, moreover, a certain curiosity about the past, and are specially interested in ruins, monuments, and history. He wants the present also to speak to him and tell its tale, hence his liking for fables and fairy tales.

Froebel closes the chapter with an enumeration of the chief faults of boyhood, which he sets out in strong terms, and traces them to one of two sources—either the development of certain sides of human nature has been wholly omitted, or certain powers and dispositions meant to be good have been wrongly developed, and directed so as to become distorted. Froebel denies the teachings of certain theologians who regard man as utterly corrupt by nature. "Surely the nature of man is good." "Man in himself is not bad, nor are any human impulses evil in themselves." "If man is to do with self-determination what is divine and eternal, it follows that he *can* and *may* do what is earthly and finite." In dealing with faults in boys, we must endeavour to find out what good tendency has been perverted, and battle with the habit by which the faulty character has been acquired. The lack of kindly feeling and the existence of selfishness arise from the failure of parental affection and the want of effort in developing the child's natural sympathies towards others. Many boyish faults arise from a want of consideration of the consequences. Froebel cites examples. Very frequently children become bad because their teachers and parents attribute to downright wilfulness acts which are simply due to want of thought.

English Language and Literature.

Read through the play again two or three times during the month with a notebook in hand, and set down short quotations which illustrate the characters of the *dramatis personæ*. We shall here deal with a few.

The King, Henry the Fifth.—In the two parts of *Henry IV.* Shakespeare represents the hero of the present play as a wild, dissolute youth. At the opening of *Henry V.* he is represented as having undergone a complete though sudden reformation on the death of his father:—

> "The breath no sooner left his father's body,
> But that his wildness, mortified in him,
> Seemed to die too; yea, at that very moment,
> Consideration, like an angel, came,
> And whipped the offending Adam out of him,
> Leaving his body as a paradise,
> To envelope and contain celestial spirits."

Henry the Fifth richly deserves his place among the "Heroes of the Nations," and his character possesses most of those traits which cause a monarch to be loved and admired by his subjects, especially in a chivalrous age. He is intensely patriotic, as is shown by his keen desire to act for his country's good, and by the high esteem in which he holds his country.

> "On, on, you noblest English,
> Whose blood is fet from fathers of war-proof!—
> Fathers that, like so many Alexanders,
> Have in these parts from morn till even fought....
> And you, good yeomen,
> Whose limbs were made in England, shew us here
> The mettle of your pasture."

He is full of the spirit of chivalry, such as it was understood in his days. We must remember that succouring the weak and showing kindness to fallen foes belong to a later development of chivalry. The opening speech of Act III., Scene iii., is quite in keeping with the spirit of the times, and Henry only belonged to his age in threatening destruction to Harfleur. We experience a feeling of relief, however, when the governor surrenders, and Henry says,—

> "Come, uncle Exeter,
> Go you and enter Harfleur; there remain,
> And fortify it strongly 'gainst the French:
> Use mercy to them all."

Again, Shakespeare brings in the fact of the slaying of the French prisoners which Holinshed also relates. Holinshed defends the act by saying that certain of the prisoners had plundered the king's tent, and then the king, "doubting lest his enemies should gather together again and begin a new field, and mistrusting further that the prisoners would be an aid to his enemies.....*contrary to his accustomed gentleness*, commanded by sound of trumpet that every man (upon pain of death) should incontinently slay his prisoner." In Act IV., Scene vi. simply says:—

> "The French have reinforced their scattered men.
> Then every soldier kill his prisoners;
> Give the word through."

In all probability Henry's real reason for giving such a command was that, as the French were renewing the attack, it is probable that the soldiers would be so anxious to keep their own prisoners, from whom they expected ransoms, that they would not readily go on fighting. They would not have had much difficulty in keeping guard over the prisoners collectively so as to prevent them from helping the French, although we read that the captives were more numerous than the captors.

He is affable and easy of access. He so won over his nobles that Westmoreland says :—

"Never king of England
Had nobles richer and more loyal subjects."

So he converses freely with the common soldiers before and after the battle: "For though I speak it to you, I think the king is but a man, as I am."

He is undoubtedly brave in battle and a skilful leader in action, but from the point of generalship his march on Calais was a huge mistake.

The Archbishop of Canterbury sums up his chief qualities in the first scene of all :—

"Hear him but reason in divinity,
And, all-admiring, with an inward wish
You would desire the king were made a prelate:
Hear him debate of commonwealth affairs,
You would say it hath been all-in-all his study:
List his discourse of war, and you shall hear
A fearful battle rendered you in music:
Turn him to any cause of policy,
The Gordian knot of it he will unloose,
Familiar as his garter:—that, when he speaks,
The air, a chartered libertine, is still,
And the mute wonder lurketh in men's ears,
To steal his sweet and honeyed sentences."

English History.

Go to the restoration of Charles the Second.

The constitutional points are generally very clearly set out in the text-books, and they must be mastered. Short biographies of the chief men of the period must be drawn up and learnt. All this is given in the books. The course of the civil war of Charles the First should be worked out with the help of a good historical atlas. Students who have not a really good one should draw a map of England on a fairly large scale, say half imperial sheet, and mark in the movements of the armies from the following notes.

In 1642 Charles set up his standard at Nottingham, and advanced westward to gather recruits; he passed through Derby and Stafford to Shrewsbury, then turned south-east towards London, passing through Birmingham. Meanwhile Essex set out from Northampton and advanced to Worcester. Then, finding that Charles was coming south, he turned east, and met the king at Edge Hill. Having suffered at the hands of Prince Rupert's cavalry, he retired on London; and the king went to Oxford, and then on towards London. But the London trained bands, or militia, offered such a show of resistance at Turnham Green, five miles from London, that he retired to Oxford. The next year, 1643, Charles arranged for a threefold advance on London. The Earl of Newcastle was to lead an army from the north; Sir Ralph Hopton was to bring one from the south and hold the country round London; while Charles himself advanced on the capital from Oxford. Newcastle defeated the Parliamentarians under Fairfax at Adwalton Moor, and advanced to Lincoln, which he captured. Considering it unsafe to leave the depot of Hull in the hands of the Parliamentarians, he besieged it. As he could not cut off the connection with the sea, the town held out until it was relieved by Manchester and Cromwell. Newcastle retired to York. The southern army, under Hopton, had more success. It gained the battle of Stratton, near Bude, advanced through Taunton, and defeated Waller at Lansdown and Roundaway Down, near Devizes. It then proceeded through Winchester, and captured Arundel. But the Cornishmen in it were anxious to get back to protect their own homes, so Hopton moved north-west, and allowed Waller to recapture Arundel; and then the two generals met at Cheriton, near Alresford. Waller was victorious, and so London was saved from fear of Hopton's advance.

The king felt that he could not begin his advance on London so long as Gloucester was garrisoned by a Parliamentary army, so he went west and laid siege to that town. The Londoners marched down to help their friends, and Charles was obliged to raise the siege. He endeavoured to prevent Essex from leading back the trainbands to London, and an indecisive battle was fought at Newbury. In this battle Falkland was killed, and in the night Charles withdrew his men and allowed Essex to continue his way unmolested. The next year Essex and Waller advanced together against Oxford, but jealousies prevented them from acting together. Waller followed the king up north towards Worcester, and was defeated at Cropredy Bridge. The king then advanced in search of Essex, who had relieved Lyme Regis and Weymouth and advanced into Cornwall. In the battle of Lostwithiel the king captured the whole of Essex's infantry, but the cavalry managed to cut their way out and escape. Essex escaped by boat to Portsmouth, and joined Cromwell, Waller, and Manchester near Reading. The combined forces then met the king's in the second battle of Newbury, which was also indecisive, and the king again retired to Oxford. In the north the Parliamentarians gained several successes, and effected a union with the Scots. In the same year Rupert advanced into Lancashire, where he gained a victory at Bolton, and raised the siege of Lathom House. He then marched across to try to raise the siege of York. He was, however, completely defeated at Marston Moor, and from that time the king's cause in the north was hopeless. In Scotland, however, Montrose had carried on a very successful struggle, and was advancing into England. Lord Leven moved into Westmoreland to prevent him from joining the king. Charles moved north to meet Montrose, but turned east; Rupert captured Leicester, and the king's forces met the combined forces of Cromwell and Fairfax at Naseby, where they were completely defeated. The king lost nearly all his officers and all his artillery and arms. The king retreated to Oxford, and Rupert to Bristol, where he was obliged to surrender to Fairfax two months later.

The victory of Naseby was due to the "New Model" army, and marks a new era in the war. There were several small campaigns fought after this, but Charles was quite unable to organise any effective plans. Hopton was defeated at Torrington, and was obliged to retreat into Cornwall, where he surrendered at Tresillian Bridge.

In 1646 the king left Oxford and joined the Scots at Southwell, near Nottingham. Montrose had advanced south, but was defeated by Leslie at Philiphaugh, near Selkirk, and Leslie was actively co-operating with the Parliamentarians. The surrender of Charles practically brought the war to a close, but there were one or two campaigns undertaken after that. The chief of these were—(1) the rising in Kent. The Earl of Norwich raised the Royalists of Kent in 1648, but was defeated at Maidstone by Fairfax; but he escaped, and shut himself up in Colchester, which Fairfax captured after three months' siege. (2) The campaign in Wales. Poyer, who was governor of Pembroke Castle for the Parliament, went over to the king's side, and took Pembroke and Tenby. Cromwell recaptured them, and then went to deal with (3) the Lancashire campaign. Hamilton had advanced into England in the king's cause, but was defeated by Cromwell at Preston, pursued to Wigan and Warrington, and obliged to capitulate at Uttoxeter. (4) The Dunbar campaign. Cromwell next advanced against Leslie, who had turned Royalist. He captured Berwick, but failing to take Edinburgh, he retired to Dunbar, where he completely defeated Leslie, who was following him up. (5) Montrose made a last effort for the Royalist cause in 1650, but was defeated and captured. (6) Campaign of Worcester. Prince Charles advanced from Stirling, and obliged Lambert to retire from Warrington; but Cromwell, who had come down from Leith, quite defeated Charles at Worcester. (7) Monk made a series of marches into the Highlands to pacify the extreme north.

Geography.

Study the physical geography of Africa.

Books of travel should be studied in this connection, and the routes carefully traced out on the map. We may just give an outline of the discoveries in connection with each of the principal rivers.

1. *Nile.*—The first modern explorer was James Bruce (1730–94), who went up as far as Khartum, and then followed up the Bahr-el-Azrek, or Blue Nile, thinking it to be the principal stream. In 1858 Captain Speke and Burton visited Lake Tanganyika, and discovered the south shore of Lake Victoria Nyanza; and in 1861 Speke and Grant explored the western shore of the lake, and discovered the White Nile issuing from its northern end. Three years later the Albert Nyanza was discovered by Sir Samuel Baker. Lake Albert Edward Nyanza was explored by Stanley in 1888, and shown to be connected with the Albert Nyanza, and he also explored the district near the head-waters of the Nile.

2. *Niger.*—This river was traced out about a hundred years ago by Mungo Park, a Scotsman, whose *Travels* form very interesting reading.

3. *Orange River.*—Most of our information respecting the Orange River is due to the explorations of Robert Moffat, the Scottish missionary (1817–60).

4. *Zambesi.*—The mouth of this river was discovered by Portuguese navigators; but in 1850 Dr. Livingstone struck upon it in its middle course, and in 1852 traced its course up for many miles, and worked his way across to Loanda. In 1854 he was again exploring the Zambesi, and worked his way down to Quilimane at its mouth. Two years later he started on his great journey, and explored the country north of the Zambesi, traced the Shiré

up to Lake Nyassa, which he carefully explored. He also explored Lake Tanganyika, which had been previously discovered by Burton and Speke. He discovered the Chambeze, and traced its course into Lake Bangweolo, up to its entry into Lake Moero. He thought that this lake formed the head-waters of the Nile, but Stanley showed that it was drained by the Congo.

5. *Congo.*—After finding Livingstone at Ujiji in 1871, Stanley undertook another journey in 1874; and after again visiting the country near Lake Albert Nyanza, he followed the course of the Lualaba, which Livingstone had thought to be connected with the Nile, and showed that it was one with the Congo. In 1880–2 he explored a great deal of the basin of the Congo.

Arithmetic.

Study percentages, interest, and discount. *Christian and Collar*, chapters xxxvi. to xliii. The special points to notice are the relation between percentages and other fractions, covered insurance, and the relation between interest and discount. Many students, in working problems in profit and loss, show great ignorance of the simplest principles of percentages, and give themselves a great deal of unnecessary trouble. The worked examples should be carefully studied, as there is scarcely an example that can be set which has not one of the same type worked out there.

Algebra.

Study ratio and proportion. The various theorems worked out in the book must be carefully studied. The principles on which they are based are extremely simple, and when once the method has been grasped, examples are all very easily dealt with.

Euclid.

Prepare *Euclid*, Book IV. The only proposition which presents any difficulty is the tenth. Before attempting the formal proof, the student should master the analysis of it. From the construction we see that CDA is an isosceles triangle, and therefore the exterior angle BCD is also double of the angle A; hence also BCD is an isosceles triangle, because the angle CDB is equal to the angle CAD.

If we draw a circle round DCA, we see that BD must touch the circle (this is the converse of III. 32, and may easily be proved negatively); hence the rectangle BA . BC is equal to the square on BD or CA—that is, the line AB must be divided in two parts in point C, so that the rectangle AB . BC is equal to the square on AC. Since ABD is an isosceles triangle, it follows that AB and AD can be taken as radii of the same circle, and BD is a line in that circle. If the student masters this analysis first, he will see the reason for each step in the construction, and master the proposition without difficulty

Elementary Science.

We spoke last month of the various functions associated with animal life, and we will now proceed to show how these are performed in the more highly-organised animals, and the way in which their organs are modified to enable them to be performed to the best advantage. We will begin with the methods of taking food, including both the liquid and solid forms. Some parasitical animals live in fluids which are rich in ready-dissolved foods, and so simply absorb it through the skin. Thus the tape-worm has neither mouth nor organs of digestion, but absorbs its nourishment through the skin from the dissolved food in the alimentary canal of its host. Many animals have a special tube or orifice for obtaining the fluid food on which they live. The leech has a sucker furnished with sharp teeth; the mosquito and flea a bristle-like tube for piercing the skin; the butterfly has a long, flexible proboscis, which it thrusts into the nectaries of flowers and sucks up its food; flies have a thick tongue terminating in a fleshy pad, sometimes armed with sharp points, and with this they lap up their food, in some cases supplying moisture to effect the solution of solid matter. Most birds drink by filling the bill or beak and letting the water run down their throat after raising the head; doves and pigeons suck up their drink, so do most quadrupeds. Dogs and cats lap, and the elephant sucks the water into his trunk and then squirts it down his throat.

Some of the lower animal forms obtain solid food in minute particles by causing currents in the water in which they live by means of whip-like filaments called cilia. Thus oysters, mussels, and such like creatures have a regular stream of water entering and leaving their bodies. As it enters it brings particles of food, and as it leaves it carries off the waste products. The amœba, of which we spoke last month, flows round little particles of solid food. The sea-anemone and jelly-fish have tentacles with which they seize their food and convey it into the hollow body-cavity which has no passage; but the indigestible part of the food is ejected by the same aperture as that by which it entered. Sea-urchins and star-fish have five teeth with which to seize their prey, and to masticate it as well. The gasteropod molluscs, such as the snail and the whelk, have a tongue covered with numerous spines with which to tear and grind the food which it grasps with its lips, the upper one of which is frequently armed with a horny plate for cutting the food. The arthropoda have various forms of limb-jaws which are best studied in the crab or the lobster, as set out in our nature study columns a month or two ago. All the members of this class move their jaws from side to side, never with an up and down motion, as vertebrates do. The sturgeon and the lamprey have no teeth, but seize their prey by sucking it. The toad, frog, and chameleon seize their prey with their tongues, which can be thrust out a great way, and are covered with a sticky secretion. The woodpecker also seizes its prey with its tongue, but this is sharp and barbed. Birds of prey seize their prey with their talons; other birds seize it with their beaks, which differ greatly in form, according to the kind of food on which they live.

Quadrupeds differ greatly one from another in their manner of seizing food. The great ant-eater and the ant-bear have long snouts that they can thrust right into the middle of an ant-hill; then they thrust out their long sticky tongues, to which the ants adhere, and are drawn into the mouth, where they are crushed by the toothless gums. These animals have no teeth, for they require none, and hence their group is known as *edentata*. Animals that chew the cud gather their food together with their lips or tongue, and bite it off with their teeth. The giraffe, which feeds on the leaves of trees, has a long neck, and twists its long tongue round a cluster of leaves; the cow gathers a tuft of grass with its tongue; sheep gather the grass with the lips, and bite it off by pressing the lower front teeth against the toothless upper front gum. Animals of the cat tribe seize their prey with their front feet, which are provided with retractile claws. They frequently hold it in their claws a long time before bringing the mouth down to it. Members of the dog tribe, on the other hand, have not the power of retracting their claws, and so they are never sharp like those of cats, being worn down by running; hence they commonly seize their prey with their mouth. A dog running after a rabbit endeavours to bite it, not to claw it. When actually eating, as, for instance, when gnawing a bone, a dog will hold the bone steady with his fore-paws. Animals that sit up on their hind feet use their fore-paws to seize their food and bring it to the mouth; hence squirrels have long digits, and the claws on the front limbs of bears are much longer than those on the hind limbs. These animals use *both* limbs to convey the food to their mouth; monkeys and men can do it with one. The crocodile seizes its prey with its jaws, and holds it under water to drown it; at the same time, owing to the fact that the external openings of the nostrils are right in the front and on a raised prominence, while the posterior openings are far back in the throat, which is separated from the mouth by a sort of valve, the crocodile is able to continue breathing till its prey is quite dead. In most other lizards the nostrils open into the mouth near the front; the same was true in the ancestors of the crocodile. Some of the larger snakes, as the boa constrictor, twist themselves round their prey and crush it by the contraction of the great muscles running down the body. Most snakes simply seize it with their jaws, which are armed with sharp teeth which point backwards. The jaws have great freedom of movement, which not only enables them to be opened very widely so as to swallow the prey whole, but the lower jaw can be moved backwards and forwards, and thus by the arrangement of the teeth the animal seized is gradually drawn into the mouth and swallowed. Some serpents are toothless. These live in trees and feed on birds' eggs, which they find in the nests. If such serpents had teeth in their gums they would inevitably break the egg-shell and lose the contents, for they have nothing to put the eggs into their mouths with. When the egg is once in the snake's mouth, the lips are closed, and the shell is broken by being pressed against two bones which project through the skin of the throat. The tongue of the snake is long and forked, and is used as an organ of touch. The snake feels his whereabouts with his tongue. Ignorant people often speak of the tongue as the "stinger," but there is no poisonous or stinging property in it. In the case of venomous serpents the poison is secreted and stored in little bags in front of the upper front teeth, which, being inserted on a little hinged bone, and not on the jaw itself, lie down inside the snake's mouth when he is at rest. When he is about to seize his prey they stand erect, and the mere pressure due to the bite, especially if the animal seized pulls the fangs forward in attempting to escape, forces some poison out of the venom sacs, which runs down a little canal in the fang, and so enters the animal.

OUR SCIENCE SECTION

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PHYSIOGRAPHY.

(ADVANCED AND HONOURS.)

Sun Spots.—Since the appearance of the large sun spots in October of this year, many interesting articles on the subject have appeared in the scientific and daily papers. Perhaps the most interesting are those written by the Rev. Father Cortie of Stonyhurst Observatory, and by Dr. Lockyer of the Solar Physics Observatory at South Kensington. The Rev. Father Cortie's paper appeared in the November number of the *Nineteenth Century*, and Dr. Lockyer's paper in *Nature* of November 5th. The following summary of the main points will be of interest to students of physiography.

A large sun-spot group appeared on the eastern limb of the sun on October 5th, and left the western limb on October 18th. This great group, at the time of maximum development, extended across the sun's disc for a distance of over 90,000 miles. The birth of this group had been to some extent anticipated, for the observers at Greenwich and elsewhere had noticed a continual and striking increase in the area of the faculæ on the face of the sun since the middle of September of last year. At periods of unusual activity on the sun, the faculæ or bright floccular appearances on the sun's disc generally become larger and more distinct, and then gradually diminish as the sun becomes more tranquil. Hence it is that the growth of the faculæ has come to be looked upon as a fairly sure sign that an increase in the number and size of the sun spots is about to take place. The periods of great activity on the sun appear to recur at regular intervals, and at the commencement of a period the rate of growth is very rapid, whilst the decline is much more gradual. A good example of this is shown in the records taken by the British Astronomical Association from 1893 to 1903.

In 1893, 285 sun spots were observed, and the number gradually fell to 73 in 1899, 45 in 1900, 21 in 1901, 21 in 1902, and then a rise to 42 in the first six months of the present year. Taking into account the size of the sun spots, and taking $\frac{1}{10000}$ of the sun's visible disc as one unit, then the drawings of the Stonyhurst Observatory show that the mean value of the area covered by sun spots in 1900 was 0·55 of a unit; in 1901, 0·29 of a unit; in 1902, 0·33 of a unit. Both sets of figures show that 1901 was a year of minimum activity. In October of this year the area covered was 2,300 units. The course of a cycle then seems to be a very rapid rise and a slow decline, and this is characteristic of all the cycles observed up to the present.

The existence of sun spots was observed by Galileo in 1610, soon after the invention of his telescope, but several observers had previously noticed them.

Father Scheiner of Ingolstadt had observed them, and projected images of them on to a screen attached to his primitive equatorial telescope. His method of observation is still employed where drawings are desired, and where eye observations are made. Scheiner was able, from his observations, to deduce the inclination of the sun's axis, and he also found that the period of rotation was approximately twenty-five and a half days. The appearance of these sun spots is readily shown by Scheiner's method, even with a telescope of only very moderate power, especially if the eye end of the telescope is in a darkened room or suitably screened from extraneous light.

The spots are best seen when near the centre of the sun's disc; for when near the eastern and western limbs, the light has to pass through a greater thickness of the vapours constituting the sun's atmosphere, and this causes the appearance to be less clear. Dr. Janssen of Meudon has obtained a fine series of photographs showing that the sun's disc is covered with a network of dark lines and knots, which are continually changing. The spots and faculæ also appear mottled in these photographs. Professor Yale of Chicago, by means of the spectroheliograph, has also obtained photographs showing that the surface of the sun is covered with a network of iron, calcium, hydrogen, and other vapours, and that these are brightest and disturbed chiefly in the regions of the sun spots.

The history of a large sun spot is usually as follows:—First a small bright patch of faculæ makes its appearance. Then a number of small black spots appear, and some of these coalesce, forming two larger spots amongst the smaller ones. The one of these two spots which is first in the march across the sun's disc is generally compact, whilst the other is somewhat broken. Sometimes the spots separate, almost as if they repelled each other, the intermediate space being filled with a train of smaller spots. The time taken to reach this stage from the birth of the spots is usually from five to seven days. The smaller spots then begin to break up slowly, and later the larger spots.

Sometimes the more compact of the two large spots remains as a dark round spot for some weeks or months after the other large one has disappeared. This general history of a sun spot has been deduced by Father Cortie from the study of over four thousand drawings of spots made at the Stonyhurst Observatory since 1881.

The average life of a sun spot disturbance is about fifty-two days.

A large sun spot generally shows a central dark portion of an irregular shape. This is called the umbra. This is surrounded by a bright ring, and from this run sharply-defined bright projections into the umbra, often parallel, or nearly so, to the edge of the umbra. Outside this ring we have a half-shaded portion, the penumbra, and the appearance of this suggests streams of luminous matter, flowing either from the circumference inwards, or from the centre outwards. Some observers hold that a sun spot is a cavity in the photosphere of the sun; others, that it is an elevation. When a large spot reaches the limb of the sun, it often appears as if a notch were cut out of the disc; but some hold that this appearance is due to a prominence blocking out the view of the edge.

Spectrum observations tell us that the spot is composed of the vapours of metals, amongst which vanadium and titanium are prominent. The spots are therefore at a very high temperature, and only appear dark in comparison with the rest of the sun. Heinrich Schwabe of Dessau was the first to point out that the periods of the maxima of sun-spot disturbances occur in cycles of about eleven years. Spoerer later pointed out that as the spots become fewer and smaller they approach the equator, and reach their minimum about latitude 8° to 10°. Before the old cycle has finished, a new one commences, by the appearances of spots about 30° on each side of the equator. The maximum is reached about latitude 16°. There is an undoubted connection in time between the prevalence of sun spots on the sun's surface and the occurrence of magnetic storms on the earth.

On Saturday October 31st of this year a severe magnetic storm was experienced at many points on the earth's surface. Telephonic and telegraphic communication was seriously interfered with. It is even stated that at Chicago some of the cables were at a potential of 675 volts when no battery was connected to them. Telegraphic communication between Paris and the rest of the world was to a great extent cut off. In New York and Sydney brilliant displays of aurora were seen, and lesser displays were also seen in Ireland and Scotland. At Stonyhurst Observatory the declination needle swung through as much as 2° 46′, and the changes in the horizontal force were so great that the instruments were unable to record them, the spot of light travelling several times right off the recording drum.

At Kew also the spots of light giving the traces on the magnetographs for declination, horizontal force, and inclination went

repeatedly off the recording sheets. The variations in the horizontal force amounted to as much as one twenty-fifth of the whole force.

Some scientists hold that such magnetic storms are caused by the sun spots; Lord Kelvin has, however, shown that it is dynamically impossible that the sun spots should produce such great changes, and this conclusion seems to be supported by a comparison of the Stonyhurst sun-spot drawings and the Greenwich magnetic records. It may be, however, that both are due to some common cause affecting sometimes the earth alone, and sometimes the sun alone, and sometimes both at the same time. We indeed sometimes have large spots without either magnetic storms or auroræ, and sometimes great magnetic disturbances without unusually large sun spots. Taking the two phenomena generally, however, the periods of great activity in each agree to a remarkable extent. Sir Norman Lockyer has endeavoured to show that there is a connection between the sun-spot periods and the yearly rainfall. We will, however, return to this question at a later date.

CHEMISTRY.

(ADVANCED AND HONOURS.)

BY C. A. WEST, B.SC., A.R.C.S., F.I.C.

Interaction of Phosphorus and Hydrazine (Johannes W. Dito in *Proc. K. Akad. Wetensh*, Amsterdam, 1903, p. 6).—Yellow phosphorus and a 90 per cent. solution of hydrazine, in the proportions of six atoms of phosphorus to one molecule of hydrazine, were left in contact in a vacuum tube for one or two months at atmospheric temperature. A black amorphous solid resulted, and a white crystalline substance was found distributed through the black mass. On opening the tube, phosphine was emitted. The white substance was extracted with alcohol, in which, unlike the black substance, it was found to be soluble. This substance, from its reactions, must be either hydrazine phosphite or hydrazine hypophosphite.

The black substance, in contact with air, absorbs moisture and becomes yellow in colour. Distilled with dilute caustic soda it gives hydrazine. Dilute nitric acid and bromine both attack it. When heated to 100° C. in a current of hydrogen it loses in weight and becomes red.

The red substance gives black substances when treated with alkalis. It contains no nitrogen, and quantitative analysis shows that it contains 91·7 per cent. of phosphorus, and 1·1 per cent. of hydrogen, while the remaining 7·2 per cent. is probably oxygen. It appears to be a weak acid, and the black substance is its hydrazine derivative.

Reductibility of some Metallic Oxides.—Silver oxide and auric oxide are so easily reduced by pure dry hydrogen that if left in contact with the gas even at temperatures considerably below 0° C. they are slowly reduced. Mercurous oxide, and both the yellow and red mercuric oxides, are reduced by hydrogen at temperatures of 80° C., 50° C., and 115° C. respectively, but not at temperatures below these.

Carbon monoxide reduces these oxides more quickly than hydrogen does, all of them except the red mercuric oxide being reduced at 0° C. The red mercuric oxide is not reduced at temperatures below 95° C., and this tends to confirm the opinion that the yellow and red varieties of mercuric oxide are chemically distinct substances.

Precipitated Crystalline Gold.—A number of reagents will precipitate gold from its solutions, but the precipitates are usually in a very ill-defined crystalline state. When, however, a dilute solution of gold chloride is treated with formaldehyde, the gold precipitate which forms slowly is in a well-crystallised form. The experiment succeeds best when an acid solution is used, and then very little gold remains in solution (less than 0·005 gram per litre). In this way gold can be quantitatively separated from solutions containing iron, copper, antimony, mercury, zinc, lead, manganese, tin, and arsenic. The specific gravity of the gold differs from that obtained by other reducing agents, and at 20° C. is 19·43095.

A New Method of Estimating Traces of Arsenic.—Armand Gautier, in *Comptes Rendu*, 1903, p. 137, describes a new method of estimating small traces of arsenic. This depends on the fact that if ferric hydrate is precipitated from a solution containing arsenic, the arsenic is carried down with it. To prepare the iron solution, dissolve ferrous sulphate in dilute hydrochloric acid, and oxidise with nitric acid. Precipitate the ferric hydrate with ammonia; filter and wash. Dissolve the precipitate in dilute sulphuric acid, add granulated zinc, and heat under reduced pressure. This almost completely removes any arsenic which may have been present. The solution is filtered from the remaining zinc, oxidised by nitric acid and ferric hydrate precipitated by ammonia. The precipitate is washed, and then dissolved in dilute sulphuric acid, and diluted so that it contains 30 grams of ferric oxide per litre. This solution now is practically free from arsenic, containing, as it does, only about ·000005 gram per litre. When a liquid is to be examined for arsenic, about 5 c.c. of this prepared solution is added, and the ferric hydrate precipitated with ammonia. This precipitate is then examined by Marsh's test.

The Advantage of a Revolving Cathode in the electrolytic separation of metals is due to the fact that it overcomes the irregularities due to the evolution of hydrogen. In the *Zeit. anorg. Chem.*, 1903, p. 35, Gooch and Medway describe their method of working. For cathode a platinum crucible is fixed to the vertical spindle of a motor. A piece of platinum foil is used as anode. The electrolytic solution is contained in a beaker on a rising table, so that its height can be altered During the early part of the electrolysis only about two-thirds of the crucible is immersed, and it is rotated at from 600 to 800 revolutions per minute. After most of the metal is deposited, water is added in sufficient quantity to cover the crucible, and the electrolysis then completed. The deposit is dried and weighed in the ordinary way. When a rotating cathode is used, a stronger current can be employed and much time saved.

Production of Helium from Radium.—Sir William Ramsay and Frederick Soddy, in the *Proceedings of the Royal Society*, 1903, p. 72, give an account of their experiments on radio-activity and the production of helium from radium. They state that the inert gases of the air show no inherent radio-activity, but that the discharging power of air noticed by some experimenters is due to extraneous radio-activity.

The emanation from radium does not seem to be affected by sparking with oxygen over alkali, neither does a heated mixture of magnesium powder and lime seem to produce any effect. After sparking the mixture with oxygen for a long time, the oxygen was absorbed by phosphorus, and there appeared to be nothing left; but when another gas was allowed to enter the tube, and was then withdrawn, it was found to be radio-active.

The radium emanation can be treated as a gas. It can be extracted by a mercury pump. It can be condensed in liquid air in a U-tube, and then washed by bubbling through it another gas which does not acquire any radio-activity. In a dark room the passage of the emanation can be seen, and compression increases the luminosity. The emanation produces chemical changes which seem identical with those produced by radium bromide. The emanation pumped from 50 milligrams of radium bromide was dissolved in water, and stored with oxygen in a glass tube over mercury. In a single night the glass turned distinctly violet. If moisture is present, the surface of the mercury becomes covered by a film of the red oxide, but is unaffected if it is dry. The emanation, when mixed with oxygen and passed through a lubricated stopcock, produced carbon dioxide.

The gas from a solution of radium bromide was collected, and was found to consist chiefly of hydrogen and oxygen. These were removed. The residue, examined spectroscopically, showed the presence of carbon dioxide. The spectrum tube was connected with a U-tube, which was then cooled in liquid air. This caused the carbon dioxide spectrum to decrease in brilliancy, and then the D_3 helium line appeared.

The radium emanation by means of oxygen was transferred to a U-tube, cooled by means of liquid air, and the oxygen then pumped away. The residue was washed with more oxygen, and then transferred to a spectrum tube. The spectrum obtained was a new one, probably that given by the emanation. After four days, however, the helium spectrum was distinctly shown.

Specific Heats at Low Temperatures.—H. E. Schmitz, in the *Proceedings of the Royal Society, 1903*, p. 72, gives an account of his experiments on specific heats at low temperatures. The following is a table of his results:—

	a.	*b.*	*c.*
Copper	0·0800	0·0793	0·0936
Thallium	0·0301	—	0·0326
Lead	0·0294	0·0300	0·03046
Aluminium	0·1724	0·1735	0·21825
Cast iron	0·0893	—	0·1189
Nickel	0·0843	0·0823	0·1094
Cobalt	0·0843	0·0837	0·10795
Zinc	0·0839	0·0849	0·0931
Silver	0·0514	0·0519	0·0559
Tin	0·0498	0·0508	0·0552

Column *a* gives the results obtained between the temperature of liquid air and the ordinary temperature by the method of mixtures. Column *b* gives the results obtained by finding the

weight of ice formed by the metal when placed in water after it has previously been cooled to the temperature of liquid air. Column *c* gives the results of determinations between 20° C. and 100° C. by the ordinary method of mixtures. Calculating the atomic heats from the above, it is evident that the atomic heat is high for metals of low atomic weights at low temperatures.

The Phosphomolybdate Reaction.—C. Reichard, in the *Chem. Zeit.*, discusses the reaction between phosphoric acid and the ammonium molybdate reagent. In order to ensure complete precipitation, he recommends that the amount of ammonium molybdate used should be to the amount of phosphoric acid roughly in the ratio of 200 to 1. Any free hydrochloric acid should be neutralised by ammonia. Certain organic acids (notably tartaric, citric, and oxalic acids), although they do not dissolve the yellow precipitate when formed, still greatly retard or even prevent the precipitation.

ELECTRICITY AND MAGNETISM.

(ADVANCED AND HONOURS STAGES.)

BY EDWIN EDSER, A.R.C.S., F.PH.S.

Luminescence.—Attention has already been directed to a class of phenomena in which the nature and extent of the radiations produced depend merely on the temperature of the radiating body. If the surface of the radiator is black, radiations will be emitted at a greater rate than if the surface is white; but this effect is independent of the nature of the gas in which the radiator is immersed. These phenomena may be classified under the head of *thermal radiation*. In another important class of phenomena, radiation is accompanied by and depends on some sort of chemical action. Thus if sodium vapour, mixed with an inert gas such as nitrogen, is heated to a high temperature, scarcely any light is emitted; but if the sodium vapour is mixed with hydrogen, a brilliant yellow light is emitted, which, when analysed by a spectroscope, shows the characteristic D lines of sodium. In this case the nature of the radiations emitted depends, not alone on the temperature of the radiating substance, but also on the nature of the surrounding gas. Such phenomena are classified under the head of *luminescence*. If wires of iron, platinum, and carbon are progressively heated so that all three at each instant are at the same temperature, then all three become luminous at nearly the same temperature; the carbon becomes luminous slightly in advance of the other substances, owing to the blackness of its surface, but the difference is not of very great importance. On the other hand, if pieces of carbon and one of the alkaline earths (such as lime or magnesia) are heated under the conditions previously mentioned, the alkaline earth glows brightly at a temperature which suffices to produce only a faint luminosity in the carbon. This phenomenon is found to depend on some sort of chemical action, since the presence of oxygen is necessary for its occurrence. The production of light by heated lime has long been utilised in the magic-lantern. The bright light emitted by burning magnesium is due to the luminescence of the small particles of magnesia formed by the combustion of the metal. Of late years Welsbach mantles have been extensively used to obtain a bright light. The mantle consists of zirconia (an oxide of the alkaline metal zirconium), and is heated in a non-luminous gas flame similar to that of a Bunsen burner. If, however, the mantle is heated in a vacuum, it soon ceases to glow. In this case also oxygen is necessary for the continued production of light. Thus the production of light by heating the alkaline earths is due to luminescence.

Since white light may be produced by luminescence at a temperature much lower than that required for its production by other means, it follows that the excitation of luminescence in suitable substances affords a ready and economical method of producing light for illuminating purposes.

One of the earliest methods of producing light by the aid of electricity involved the excitation of luminescence. The Jablockoff candle consisted of two rods of carbon placed parallel to each other, but at a short distance apart, and enclosed in a cylinder of plaster of Paris. An arc was formed between the ends of the carbons, and the plaster between them was thus heated and caused to become luminescent. Owing, however, to the unequal rate at which the carbons wore away, as well as the difficulty of starting the arc automatically, the Jablockoff candle soon fell into disuse.

In recent years a successful attempt has been made to excite luminescence electrically. This attempt utilises a property common to many substances: glass and many other so-called insulators acquire the power of conducting electricity when the temperature is raised to a suitable degree. A rod of magnesia (magnesium oxide) is a non-conductor at ordinary temperatures, but becomes a conductor at a high temperature. If, then, a rod of magnesia is heated until it acquires sufficient conductivity, and is then included in an electrical circuit of sufficient voltage, the current flowing through the rod may be used to heat it to the point at which luminescence is produced. Further, a rod of zirconia will produce more light than one of magnesia, just as the ordinary Welsbach mantles are more efficient than one made of magnesia would be.

At this point a difficulty presents itself. Experiment shows that as the current flowing through a rod of magnesia is increased, the drop of potential between the ends of the rod diminishes. This circumstance renders the arrangement unstable. On starting the current, the rod rapidly increases in brightness, but soon becomes vaporised or broken by the excessive heat produced. A similar difficulty, together with the contrivance used to overcome it, was mentioned in the article devoted to the arc lamp.

The Nernst Lamp.—This consists essentially of a thin rod, termed the *glower*, made from one of the alkaline earths, with a heater which, on starting the lamp, raises the temperature of the glower until it becomes a conductor, and a series resistance which renders the arrangement stable.

The glower and heater are shown in Fig. 1. The glower is a thin straight rod of zirconia mixed with thoria (oxide of thorium). It lies along the axis of the heater, which consists of a delicate rod of porcelain wound round with thin platinum wire, the rod being bent into the form of a spiral. On starting the lamp, a

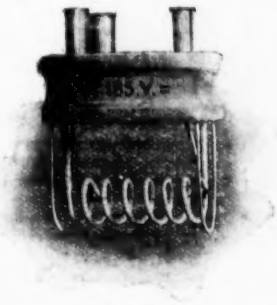


Fig. 1.

Fig. 2.

current flows along the platinum wire, and renders it and the porcelain on which it is wound red hot. The heat radiated raises the temperature of the glower till it becomes a conductor, after which the current flowing along the glower maintains a sufficiently high temperature.

In series with the glower is a thin iron wire enclosed in a glass vessel filled with hydrogen (Fig. 2). This is termed a *ballasting resistance*. When an increasing electric current is sent through such an arrangement, the drop of potential in the wire at first increases at a nearly uniform rate with the current. At a certain point the drop of potential commences to increase very rapidly

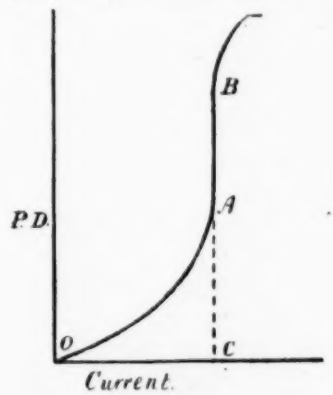


Fig. 3.

as the current increases. Fig. 3 shows graphically the relation between the P.D. and the current. It will be noticed that part of this curve, from A to B, is vertical; which shows that an

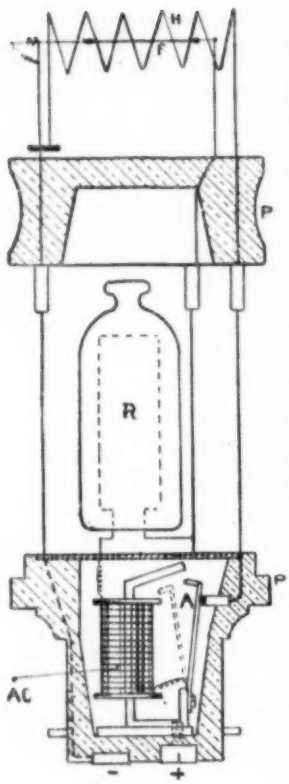


Fig. 4.

infinitesimal increase in the current produces a very large increase in the P.D. Conversely, when the current has the value OC, the voltage may increase from CA to CB without producing any appreciable alteration in the current. Thus this arrangement tends to maintain the current constant, in spite of the instability of the glower and of accidental variations in the supply voltage.

The mechanism of a Nernst lamp is represented in Fig. 4. The current enters the lamp at the positive terminal (+), and by way of the elastic iron tongue A reaches the connecting wire PP, and so, after traversing the heating spiral H, leaves the lamp by the negative terminal (−). Another parallel circuit includes a wire joining + to one end of the solenoid AC, the other end of which is connected to the ballasting resistance R, which in its turn is connected to one end of the glower F, the other end of F being directly connected to the negative terminal (−). At first the glower is a non-conductor, and so no current flows round the second circuit. When, however, the glower has become sufficiently heated to conduct an appreciable current, the latter, flowing round the solenoid AC, magnetises a bent iron rod passing through the solenoid, and draws the iron tongue A aside to the position indicated by the dotted lines. This, of course, breaks the heating circuit, which is no longer required, since the current in the glower suffices to maintain a sufficient temperature. The glower of a Nernst lamp must be surrounded by air, or luminescence soon ceases to be produced. In this case, as in that of the Welsbach mantle, it is the oxygen of the air which is the active promoter of luminescence. It appears that the conductivity of the glower is electrolytic in character, involving the reduction of the alkaline earth at the negative terminal of the glower, and the evolution of oxygen at the positive terminal. Accordingly the two ends of the glower must be fixed in different ways, in order to avoid rapid destruction of the filament, and the lamp must always be joined up with the proper end of the glower connected to the positive main.

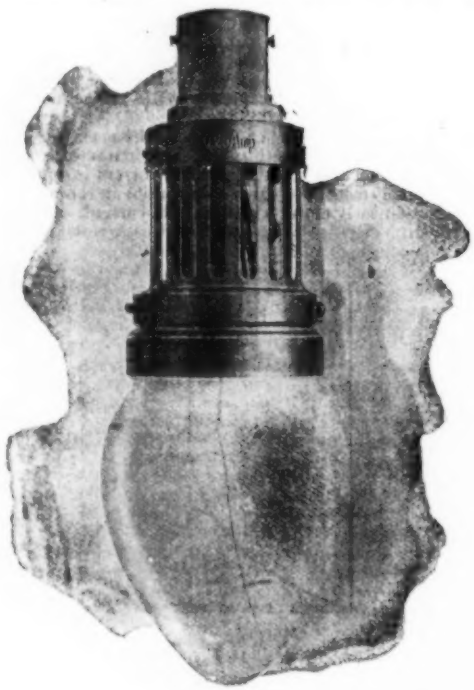


Fig. 5.

The external appearance of a complete Nernst lamp is shown in Fig. 5.

In spite of the energy dissipated in the ballasting resistance, the efficiency of a Nernst lamp is very high. Small lamps, taking half an ampere at 100 volts, give about 34 candle power, thus requiring the expenditure of 1·8 watts per candle power. A glow lamp would require about four watts per candle power, so that, on the same 100 volt supply mains, a Nernst lamp will require about the same current as a glow lamp, but will emit twice the candle power. The P.D. between the terminals of the ballasting resistance is about fifteen volts. The "Luna" Nernst lamp is said to require, on a 200 volt circuit, no more than about 0·9 watt per candle power. The following comparison of cost will show the saving effected by the use of a Nernst lamp in a run of 1,200 hours. The figures refer to a 210 volt ½ ampere Nernst lamp, giving 32 candle power, and a 210 volt glow lamp, also giving 32 candle power, but requiring about 0·6 ampere. It should be remembered that the Board of Trade unit of energy is equal to 1,000 watt hours.

Nernst Lamp.	£	s.	d.
Original cost	0	5	0
Cost of renewals	0	3	0
Cost of energy, at the rate of 52½ watts for 1,200 hours, or 52½ × 1,200 = 63,000 watt hours, at 5d. per unit	1	6	3
Total cost for 1,200 hours	£1	14	3

Glow Lamp.	£	s.	d.
Original cost	0	1	0
Cost of renewals	0	1	0
Cost of energy, at the rate of 120 watts for 1,200 hours, or 144,000 watt hours at 5d. per unit	3	0	0
	£3	2	0

Thus, in spite of its greater cost, a considerable saving is effected by the use of a Nernst lamp.

THEORETICAL MECHANICS.

(ADVANCED AND HONOURS STAGES.)

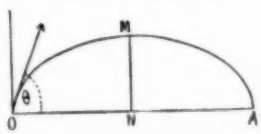
BY FRANK CASTLE, M.I.M.E.,

Royal College of Science; Lecturer on Mechanics, etc., Morley College, London; Author of "Elementary Practical Physics," "Practical Mathematics," etc.

Motion of a Projectile.—If a particle is projected from a point O with velocity V, and in a direction making an angle θ with the horizon, it may be easily verified that the path of the particle is a parabola.

The horizontal component of V is V cos θ.

The vertical component of V is V sin θ.



The former remains unaltered for all positions of the particle; the vertical component alone alters gradually, diminishing until at the highest point it is, for the instant, at rest. It then commences to descend, reaching the horizontal plane through O at a point A. At this point the vertical velocity is the same as at O, but in the opposite direction.

The vertical velocity v at any instant may be obtained from the equation—

$$v = V \sin\theta - gt.$$

At the highest point, M, the particle is for the instant considered at rest. $\therefore v = 0$. Hence

$$V \sin\theta = gt. \quad \therefore t = \frac{V \sin\theta}{g} \quad . \quad . \quad . \quad . \quad (1)$$

The time of flight, or the time taken in passing from O to A, is obviously twice that given by Eq. (1).

$$\therefore t = \frac{2V \sin\theta}{g} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

The height h at any time t may be found from the equation $h = Vt \sin\theta - \frac{1}{2}gt^2$. . . . . (3)

To find the greatest height it is only necessary to substitute the value of t from Eq. (1) in Eq. (3).

$$\therefore h = \frac{V^2 \sin^2\theta}{g} - \frac{1}{2}g \times \frac{V^2 \sin^2\theta}{g^2} \quad .$$

$$= \frac{V^2 \sin^2\theta}{g} \quad .$$

The *range* or the distance OA is obviously the product of the horizontal component of the velocity and the time of flight.

$$\therefore \text{range} = V \cos\theta \times \frac{2V \sin\theta}{g}$$

$$= \frac{2V^2 \sin\theta \cos\theta}{g} = \frac{V^2 \sin 2\theta}{g} \quad . \quad . \quad (4)$$

As V and g are both constants, it follows from (4) that the range will be a maximum when $\sin 2\theta$ has its greatest value, but the maximum value of the sine of an angle is unity.

$$\therefore \sin 2\theta = 1 = 90°. \quad \text{Thus } \theta = 45°.$$

It follows, therefore (neglecting resistances), that the range is a maximum when the angle of elevation is 45°. Students familiar with elementary applications of the calculus can easily obtain the same results by differentiation.

Also, as $\sin\theta = \sin(180° - \theta)$, it follows that in general two values of θ satisfying Eq. (4) can be obtained—that is, for a given range two angles of projection are possible.

Ex. 1. Supposing that a gun elevated to 90° can send a shot to a height of h feet to keep in the air T seconds, prove that at an elevation α the range on a horizontal plane will be $2h \sin 2\alpha$, with a time of flight of T $\sin\alpha$ seconds, and the greatest height attained will be $h \sin^2\alpha$, neglecting the resistance of the air.

Prove that the velocity required for a range of 20 miles will be at least 1840 feet per second, with a time of flight of 81 seconds. (Inter. 1901.)

As the angle of elevation is 45° for maximum range, $\sin 2\theta = \sin 90°$. Also range = 20×5280 feet.

$$\text{Hence from Eq. (4) } 20 \times 5280 = \frac{V^2}{g}.$$

$$\therefore V = \sqrt{20 \times 5280 \times g}$$

$$= 1840 \text{ feet per second.}$$

$$\text{Time of flight} = \frac{2V \sin\theta}{g} = \frac{2 \times 1840 \times \sin 45°}{g}$$

$$= 81{\cdot}3 \text{ seconds.}$$

Ex. 2. Prove that the elevation α required to attain a horizontal range of X feet with initial velocity V feet per second is given in the absence of resistance by

$$\sin 2\alpha = \frac{gX}{V^2}.$$

Also prove that the shot will rise $\frac{1}{4}X \tan\alpha$ feet. (Inter. 1901.)

Ex. 3. Prove that the claim for a rifle that the bullet does not rise more than one inch in a range of 100 yards implies that the initial velocity must be greater than 2078 feet per second. (Inter. 1902.)

Ex. 4. Given the initial velocity and the range of a projectile, show that in general two angles of projection are possible.

If the initial velocity be 420 feet per second, and the range 1800 yards, show that the angle of projection is either 39° 12′ or 50° 48′.

[*N.B.*—$49 \sin 78° 24' = 48$.] (1902.)

Some examples dealing with momentum, energy, and work have already been given in these notes. The sections referred to are so very important, and have such far-reaching applications, that as much time as possible should be devoted to the task of becoming fully acquainted with at least some of their numerous applications; and, as already indicated, a student should be able not only to write out clearly and quickly the necessary proofs of the formulæ, but also to obtain, where possible, numerical results. In many cases it is necessary to write down and rearrange the formulæ so that numerical results are readily obtainable. Again, in many cases it will be found that the formula or formulæ used are not necessarily those which will give the result in the shortest or simplest form; but it should be noticed that even a roundabout method, so long as the various steps are legitimate and consistent, must eventually lead to the required result, and is frequently easier to handle and apply than a shorter and more direct method.

Thus, in some problems that may occur two or more methods of solution may be adopted, and it does not follow that the shortest is necessarily the simplest. This may be illustrated by the following problem, which is taken from a recent B.A. Examination paper:—

Ex. 1. A lift ascending from a pit 600 feet deep rises during the first part of its ascent with uniform acceleration. On nearing the top the upward force is cut off, and the impetus of the lift is just sufficient to carry it to the top. If the whole process occupies half a minute, find the acceleration during the first part of the ascent; find also the maximum velocity attained. (B.A. Ex.)

The force acting on the lift is such as to give uniform acceleration to it during the first part of its ascent, and starting from rest it attains a maximum velocity. Then, when the force ceases to act, the force of gravity acting on the moving system reduces the velocity, until finally the lift is for the instant considered at rest. Let t_1 denote the time during which the force acts. If a is the acceleration and v the maximum velocity attained, then $at_1 = v$; if t_2 is the time during which the lift is brought to rest by the action of gravity, then $gt_2 = v$.

$$\therefore t_1 = \frac{v}{a}, \text{ and } t_2 = \frac{v}{g}.$$

$$t_1 + t_2 = 30 = \frac{v}{a} + \frac{v}{g} = v\left(\frac{1}{a} + \frac{1}{g}\right) \quad . \quad . \quad . \quad . \quad (1)$$

If s_1 and s_2 denote the corresponding spaces, then

$$s_1 = \frac{a}{2}t_1^2 = \frac{v^2}{2a}; \text{ also, } s_2 = \frac{v_2}{2g}.$$

$$\text{Hence } s_1 + s_2 = v^2\left(\frac{1}{2a} + \frac{1}{2g}\right) = 600. \quad . \quad . \quad . \quad (2)$$

From these equations we may obtain $v = 40$ ft. per sec., and $a = \frac{32}{23}$ ft. per sec. per sec.

The problem admits of a simpler solution, which may be obtained as follows:—

Let v denote the maximum velocity of the lift. Then from the relation (average velocity) × (time) = space described, we obtain

$$\frac{v}{2} \times 30 = 600. \quad \therefore v = 40 \text{ ft. per sec.}$$

We can readily find the distance through which the lift moves before it is brought to rest from the relation $v^2 = 2gx$.

$$\therefore x = \frac{1600}{64} = 25 \text{ ft.}$$

Hence the force acts through a distance of $600 - 25 = 575$ ft. To find the acceleration we may use the relation $v^2 = 2as$.

$$\therefore a = \frac{1600}{2 \times 575} = \frac{32}{23} \text{ ft. per sec. per sec.}$$

The preceding will serve to emphasise the importance of remembering the more important formulæ or of having some ready means of obtaining them with facility. In some cases, although a numerical answer may not be required, the formulæ have to be rearranged and presented in a definite form indicated by the problem. The following is a typical example of this kind, and will illustrate how the various formulæ have to be combined to obtain the required result:—

Ex. 2. (*a*) Determine the velocity acquired by a block of wood weighing W lbs., free to recoil backwards in a straight line when struck directly by a bullet weighing w lbs. moving with a velocity of v feet per second.

(*b*) Prove that if the bullet is embedded a feet the resistance of the wood to the bullet, supposed to be uniform, is—

$$\frac{Ww}{W+w} \times \frac{v^2}{2ga} \text{ lbs.}$$

(*c*) Also prove that the time of penetration is $\frac{a}{2v}$ seconds, during which the block will move through a distance $\frac{wa}{W+w}$ feet. (B.Sc., 1901.)

If V denotes the velocity with which the block of wood begins to recoil, then, as the bullet is embedded in it, its mass is $\frac{W+w}{g}$.

Hence $\left(\frac{w}{g}\right)v = \left(\frac{W+w}{g}\right)V$, since the momentum acquired by the block is equal to that of the bullet.

$$\therefore V = \frac{wv}{W+w}. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The energy of the system $= \frac{W+w}{2g}V^2$.

Substituting the value of V from (1), we obtain—

$$\left(\frac{W+w}{2g}\right)\frac{w^2v^2}{(W+w)^2} = \frac{w^2v^2}{2g(W+w)}.$$

Hence loss of energy

$$= \frac{wv^2}{2g} - \frac{w^2v^2}{2g(W+w)} = \frac{wv^2(W+w) - w^2v^2}{2g(W+w)} = \frac{wWv^2}{2g(W+w)}. \quad (2)$$

The loss of energy of the bullet is the energy given to the block, and its numerical magnitude can be obtained from (2) when W, v, and w are known.

If R denotes the mean or uniform resistance of the block, and a the distance to which the bullet is embedded, then we have the relation—

$$Ra = \frac{Wwv^2}{2g(W+w)}. \quad \therefore R = \frac{Ww}{W+w} \times \frac{v^2}{2ga}.$$

In a similar manner the relation given by (c) may be obtained.

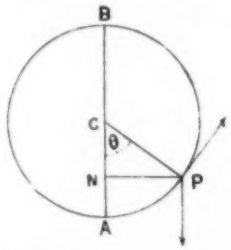
Motion in a Circle.—Suppose that a particle of mass m moves in a circular path of radius r, then for each successive position of the particle there may or may not be acceleration in the direction of the tangent, but there is acceleration in a radial direction. If the particle be assumed to move with uniform velocity v feet per second, then the acceleration or time-rate of gain of velocity in the direction of the tangent is zero. The acceleration along the radius is $v^2 \div r$ in a direction towards the centre of the circle.

From the relation $F = Ma$, we find $F = \frac{mv^2}{r}$ . . . . (1)

In (1) when r is measured in feet, m in pounds, then F is given in poundals. To obtain F in pounds it is necessary to divide by g.

$$\therefore F = \frac{mv^2}{gr} \text{ lbs.}$$

The preceding strictly applies to the case where the particle is assumed to describe a horizontal circle. If we assume the particle connected to the centre by a piece of fine string, and to move in a vertical circle, then the tension in the string will vary for successive positions of the particle; it will be greatest when the particle is in its lowest position, and least when it is in its highest. To find an expression for the tension at any point of the circle, we may proceed as follows:—



Let P denote the position of the particle at a given instant, and let v be its velocity. The forces acting on P are its weight mg, the force $\frac{mv^2}{r}$ in a direction inwards along PC and the tension T of the string.

Let PC make an angle θ with the vertical diameter AB; then the tension in the string will be the force $\frac{mv^2}{r}$ together with the component of mg in the direction of the string.

$$\therefore T = \frac{mv^2}{r} + mg \cos \theta.$$

Let AN $= h$, also let V^2 denote the velocity of the particle as it passes its lowest point.

Then $v^2 = V^2 - 2gh$, and substituting this value in (1), we obtain—

$$T = mg \cos \theta + \frac{m}{r}(V^2 - 2gh).$$

This may be written in the form—

$$T = \frac{m}{r}\{V^2 + g(r \cos \theta - 2h)\}. \quad . \quad . \quad . \quad . \quad (2)$$

A special case of some importance is to find a value of V such that the particle will just make a complete revolution without the string ever becoming slack. This will obviously be the case when the tension at the highest point B is zero—that is, when $\theta = 180°$, and $\cos 180° = -1$; also, $h = 2r$. Hence from (2) we obtain—

$$0 = \frac{m}{r}(V^2 - gr - 4gr).$$

$$\therefore V^2 = 5gr, \text{ or } V = \sqrt{5gr}.$$

The tension at the lowest point is given by—

$$T = \frac{mV^2}{r} + mg = 5mg + mg = 6mg.$$

$\therefore$ tension of string at lowest point is six times the weight of the particle.

Ex. 3. A weight is whirled round in a vertical circle at the end of a string. Show that if it revolves without the string ever becoming slack, the tension of the string at the bottom of its path will be at least six times the weight.

(Inter., 1901.)

Ex. 4. Prove that the smallest radius on which a motor car can turn without upsetting at a velocity V feet per second is $\frac{2V^2}{g}\frac{h}{a}$ feet, where h is the height of the centre of gravity above the ground, and a the width of the track of the wheels.

(Inter., 1901.)

If r is the radius of the track, then the radial force when the car is moving with velocity V is $\frac{WV^2}{gr}$, where W is the weight of the car.

Let $F = \frac{WV^2}{gr}$. Then when the car is just on the point of overturning, we have, taking moments,

$$Fh = \frac{Wa}{2}. \quad \therefore F = \frac{Wa}{2h}.$$

$$\text{Hence } \frac{Wa}{2h} = \frac{WV^2}{gr}. \quad \therefore r = \frac{2V^2}{g} \times \frac{h}{a} \text{ feet.}$$

RADIUM.

BY C. A. WEST, B.SC., F.I.C., A.R.C.S.

DURING the last year a great deal of public interest has been shown in the research work on radio-activity, which has been so very actively prosecuted since the discovery of radium. So many contradictory reports of the new discoveries which have been made have appeared in the press, that a *résumé* of the actual facts, together with some account of the explanations given of these, will be welcomed by the readers of the *Practical Teacher*.

In 1896, M. Henri Becquerel was experimenting on phosphorescent substances, and amongst other experiments he intended to find if sufficient phosphorescence could be excited in the double sulphate of uranium and potassium to affect a photographic plate through a layer of black paper.

Some other phosphorescent substances had been found to do this. The salt was sprinkled on the paper containing the plate; but as it was considered that there was not sufficient sunshine at the time to promote the phosphorescence, the plate was placed in the dark for a few days. This plate was afterwards developed, without the salt being exposed to direct sunlight, and it was found that the plate had been affected. Later experiments have shown that uranium salts retain their remarkable property even after being kept in the dark for several years. The radiation which was affecting the plate in such a case could then scarcely be looked upon as a case of phosphorescence. These new rays were termed the Becquerel rays, after their discoverer, and they very closely resemble the Röntgen or X-rays. These rays, it was afterwards found, if placed near a charged electroscope, quickly discharged it. They appear to differ from the cathode rays of a Crookes's tube in that they are not turned aside or deflected by a magnet.

M. Pierre Curie and his wife, Mme. Sklodowska Curie, experimented on a number of minerals containing uranium. Now, it had been found that the radio-activity of uranium compounds was roughly proportional to the amount of uranium present; but M. and Mme. Curie found that in the case of pitchblende the radio-activity was much greater than could be accounted for on this supposition. This led Mme. Curie to believe that this extraordinary activity was due to an unknown metal contained in the pitchblende. She therefore decided to analyse the

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mineral chemically. Pitchblende contains uranium, iron, lead, bismuth, barium, oxygen, and other elements. She soon came to the conclusion that the radio-active substance she was seeking was thrown down with the sulphides. The radio-active substance seemed to be closely identified with bismuth, and she termed the new substance which she thought she had thus proved to exist "polonium," after her native country, Poland. No further proof, however, has been brought forward in support of the evidence that polonium exists. On examining the residue from the sulphide group, Mme. Curie unexpectedly found that this possessed much greater activity than the sulphide group itself. Carrying on the analysis further, she discovered that the barium group seemed to contain some substance with a very great radio-activity.

This new substance behaved very much like barium in its chemical properties, being carried down in the precipitate when barium was precipitated as sulphate, carbonate, or chloride; but, like barium, it was not precipitated from an acid solution by sulphuretted hydrogen, nor by ammonia or ammonium sulphide. It was found, however, that by repeatedly precipitating the chloride with alcohol, it was possible to concentrate the radio-active material in the precipitate. By long-continued fractional precipitation, the chloride of this new substance was obtained in a presumably pure state. The new element itself has not yet, however, been isolated, only salts such as the chloride and bromide having been prepared.

The Curies christened the new element "radium," because of its intense radio-activity. It must be remembered, then, that when we speak of the radio-activity of radium, we are really only referring to the radio-activity of its salts. It is estimated that the radio-activity of radium salts is, roughly, one million times as great as that of uranium salts. The amount of radium in pitchblende is so minute that, on examining the original mineral by the spectroscope, no indication of it is seen, and it is only after the concentration process has proceeded to a considerable extent that the spectrum makes its appearance. The spectrum has been observed by M. Demarcay, by Sir William Crookes, and by Professor Rungé, and the spectrum of the bromide is chiefly characterised by the line 4,826 in the blue.

The present source of the radium salts is the refuse of the uranium oxide works at Joachimsthal. It is estimated that at least one hundred and fifty tons of the refuse would have to be worked up to furnish one ounce of radium. Probably the whole amount of radium bromide prepared up to the present does not exceed four grams, and the price may be put roughly at about £1,500 per gram.

Mme. Curie determined the atomic weight of radium to be about 225; but the spectrum seems to indicate that it is really higher than that of uranium, which is 240, the highest known. It is possible that the sample analysed by Mme. Curie was contaminated with barium, which has an atomic weight of 137.

It was found that the radiations given out by radium salts were of several different kinds. The bromide when placed in the dark is seen to be self-luminous, and the rays emitted affect a photographic plate, like the Becquerel rays or the Röntgen rays. The radiations cause a screen of platino-cyanide to phosphoresce, just as the X-rays do. They are also capable of penetrating considerable thicknesses of various materials, such as wood and aluminium.

Radium salts also appear to be able to excite a temporary radio-activity in substances placed near them in an enclosed space, but this activity gradually dies away after the radium salts are removed.

Whilst the researches on radium were being carried on, M. Curie and Dr. Schmidt simultaneously discovered that thorium, an element with an atomic weight 232, has also the power to discharge an electroscope; and what is more remarkable still, if air is led over salts of thorium, the air acquires the power of discharging an electroscope, and retains this for some time. Professor Rutherford of Montreal and Mr. Frederic Soddy investigated the matter further, and found that on passing this radio-active air through a tube cooled with liquid air, the issuing gas had been robbed of its activity. The active portion had evidently been retained by the cold tube. On warming the tube this came forward, and was seen to be still radio-active. The discharging power, however, only lasted for a few minutes. When they repeated the experiment, using radium salts, they found that the same thing occurred, only that the activity was very much more pronounced, and that the issuing gas retained its radio-activity for at least a month. It was also self-luminous, and imparted temporary luminosity to objects which it touched.

The Curies have shown that radium is always warmer than its surroundings. If surrounded by a vessel kept at constant temperature, the radium salt is always about 1·5° C. higher than the enclosure. It gives out sufficient heat to melt its own weight of ice every hour. Such are some of the principal observations which have been made with respect to radium compounds; but much detailed work has been done, of which the following gives the chief results.

The *radiations* given out by radium are of at least three different kinds. The three known distinct kinds of rays are known respectively as the "α" "β," and "γ" rays.

The α rays can be filtered out or absorbed by passing the rays through a sheet of aluminium. These rays discharge a negatively charged electroscope, and Professor Rutherford, by employing a very strong magnetic field, has shown that they are deflected by a magnetic field, but in the opposite direction to that in which the cathode rays of a Crookes's tube are deflected.

It is probable, therefore, that these rays consist of particles of matter with large charges of positive electricity. These particles, according to the calculations of Professor Rutherford, have a mass probably of the same order as that of the hydrogen atom, and travel with a velocity about one-tenth that of light. These particles, if allowed to fall on a screen of "Sidot's hexagonal blende" (a naturally occurring zinc sulphide, excite sufficient phosphorescence in it to be distinctly visible. A small instrument, the spinthariscope, invented by Sir William Crookes, is designed to show this, and consists of a tube with a lens at one end and a zinc sulphide screen at the other. Behind the screen is a minute particle of a radium compound. On examining the screen by means of the lens, it is seen to be sparkling with ever-changing points of light, which are probably due to phosphorescence, excited by the bombardment of the screen by the α rays.

The β rays are capable of passing through a considerable thickness of aluminium. The intensity of the α rays is halved by passing through a thickness of ·005 mm. of aluminium, whilst it requires a thickness of ·5 mm. to produce a similar effect on the β rays. A sheet of mica ·1 mm. thick seems to have no effect on the β and γ rays, whilst it filters out practically all the α rays. The β rays are much more readily deflected by a magnetic field than are the α rays. The β rays will discharge a positively charged electroscope, and they therefore consist of material particles carrying charges of negative electricity. It seems probable that they will prove to be identical with the cathode rays of a vacuum tube. The mass of the particles constituting the β rays is probably about one-thousandth part of that of a hydrogen atom, and the velocity with which they are projected is probably nearly that of light (Rutherford and Soddy, *Phil. Mag.* May 1903). The smaller size and greater velocity of the β rays explain to some extent why they are more penetrative than the α rays.

The γ rays are much more penetrative than the β rays, and require a thickness of about 8 cms. of aluminium to reduce their intensity to one-half. They are small in quantity, and seem probably to be identical with the X-rays. They probably consist of a wave motion in the ether, and not of material particles.

The radio-active Emanation.—Sir William Ramsay was much struck by the experiment of Professor Rutherford and Mr. Soddy, in which they showed that the radio-active air produced by air bubbling through a solution of a thorium salt could be apparently deprived of its activity by passing it through a spiral cooled by liquid air.

Professor Rutherford and Mr. Soddy, in November 1902, came to the conclusion that thorium and radium both gave off a gas or gases, which were condensed in the tube; and when Mr. Soddy came to England, in the spring of 1903, to work with Professor Ramsay, the latter decided to put the matter to the test. A supply of a radium salt was placed in an exhausted vessel, which communicated with a bulb surrounded by liquid hydrogen. The condensed gas was pumped into a tube, and examined spectroscopically, when it was found to be helium. Professor Ramsay states that the fresh emanation from radium does not show the spectrum of helium, but a spectrum distinct from that of any known substance. It, however, seems gradually to decay, and helium appears in ever-increasing quantity. It therefore seems as if radium is gradually breaking up, and giving rise to a comparatively great amount of energy in so doing. It gives off at least three kinds of rays, and also a gas which changes to helium.

These astounding results have already caused chemists and physicists to discard many of their previous ideas with regard to the constitution of matter. We can no longer regard the atom as the ultimate particle of matter. We are also practically compelled to admit that it is possible for one element to change into another, or at least break up, giving rise to another element of lower atomic weight in the process.

Although radium seems thus to break up, it is estimated that a gram of radium would last something like two million years before it all disappeared, so slow is the rate of change.

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The condition that two curves should touch each other is that for a certain value of x the y's of the curve are equal, and also the $\frac{dy}{dx}$ of the one curve is equal to the $\frac{dy}{dx}$ of the other.

Hence, if the given curves are to touch, x must satisfy the equations

$e^{-ax}\cos bx = e^{-ax}$, $-be^{-ax}\sin bx - ae^{-ax}\cos bx = -ae^{-ax}$.

$\cos bx = 1$ obviously satisfies these equations.

$\therefore bx = 0, 2\pi, 4\pi, \ldots$ etc.

The tangent at any point x, y is given by the equation

$$Y - y = \frac{dy}{dx}(X - x),$$

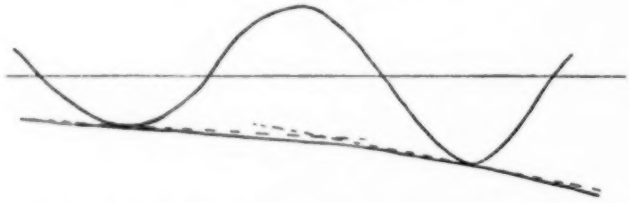
where X, Y are the current co-ordinates.

Taking the point whose x co ordinate is $\frac{2\pi}{b}$, the common tangent at that point is

$$Y - e^{-a\frac{2\pi}{b}} = -ae^{-a\frac{2\pi}{b}}\left(X - \frac{2\pi}{b}\right).$$

Next taking the point whose x co-ordinate is $\frac{4\pi}{b}$, the common tangent at that point is

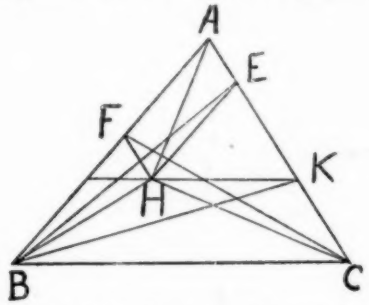
$$Y - e^{-a\frac{4\pi}{b}} = -ae^{-a\frac{4\pi}{b}}\left(X - \frac{4\pi}{b}\right).$$



Perplexed.—Our solution is correct. You may verify it in the following way:—

The bill is for £1030. The creditor receives £515 and a bill for £515 at twelve months. Hence at the end of six months the creditor has received £515 + interest on £515 for six months at 3 per cent. per annum—that is, £515 + £15, 9s., or £530, 9s. Also he holds a bill for £515, payable in six months more, and therefore worth £500. Therefore at the end of six months the creditor has in money and money's worth £515 + £15, 9s. + £500, or £1030, 9s. Under the original arrangement he would have received £1030 at the end of the six months. Hence by the new arrangement he gains 9 shillings.

Vivian.—ABC is a triangle. In AC a point E is taken, and in AB a point F; the parallelogram AEHF is completed, and BE, CF are joined. Prove that if E, F move along the sides of the triangle in such a way that the sum of the areas of the triangles AEB, AFC remains always the same, H moves along a straight line parallel to BC. (Cambridge Junior, 1901.)



Find a point K in AC such that the area of the triangle AKB may equal the given sum of the areas of the triangles AEB, AFC. (Euclid, I 44.)

Then K is fixed point. Join HA, HC, HB, HK.

Since $\triangle$ ABK = $\triangle$ ABE + $\triangle$ EBK,

and $\triangle$ ABK = $\triangle$ ABE + $\triangle$ AFC,

$\therefore \triangle$ EBK = $\triangle$ AFC.

But $\triangle$ AFC = $\triangle$ AHC, because these triangles are upon the same base AC, and between the same parallels AC, FH.

$\therefore \triangle$ AHC = $\triangle$ EBK.

But $\triangle$ AHC = $\triangle$ AEH + $\triangle$ HEK + $\triangle$ KHC,

and $\triangle$ EBK = $\triangle$ EBH + $\triangle$ HEK + $\triangle$ KHB.

$\therefore \triangle$ AEH + $\triangle$ KHC = $\triangle$ EBH + $\triangle$ KHB.

But $\triangle$ AEH = $\triangle$ EBH, because these triangles are on the same base EH, and between the same parallels EH, AB.

Therefore $\triangle$ KHC = $\triangle$ KHB, and hence KH is parallel to BC.

The point H therefore lies on a line parallel to BC.

Bike.—Prove that a man weighing w lbs., moving about in the cage of a lift equilibrated by a counterpoise of W lbs., will experience an apparent relative field of gravity $2Wg/2W - w$. (B.Sc., Lond.)

The acceleration is obtained from the relation

force = mass × acceleration.

$$\therefore \text{acceleration} = \frac{\text{force}}{\text{mass}} \quad \ldots\ldots \quad (1)$$

In the given example the moving force is the weight of the man = w lbs. The mass moved is $2W + w$, where W is the weight of the lift, and also the equivalent counterpoise.

$$\therefore \text{acceleration} = \frac{w}{2W + w} \times g.$$

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As the weight of the man is w lbs., the force from (I) is

$$\frac{w^2}{2W + w}g.$$

Hence apparent weight $= \left(w - \frac{w^2}{2W + w}\right)g.$

$\therefore$ apparent relative field of gravity $= \frac{2Wg}{W + w}$.

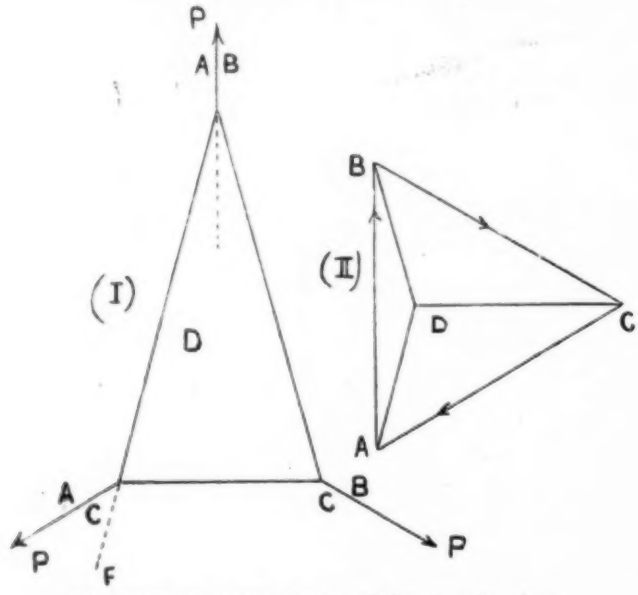
The result also follows from the relation—

$$\text{Relative acceleration} = g - \frac{w}{2W + w}g = \frac{2Wg}{W + w}.$$

The result obtained implies that the negative sign in the denominator should be replaced by a positive sign.

Barry.—Three weightless rods, AB, AC, BC, are fastened together at the angles to form the isosceles triangle, whose vertical angle BAC is 30°. The figure is kept at rest by a force P at A bisecting BAC, and two forces, each equal to P, at B and C. Prove that the equilibrium will not be affected if the rods be replaced by flexible strings knotted together at the ends, the forces acting outwards from the triangle. Find the tension of the strings.

Each of the forces acting at the angular points of the triangle may be resolved into two forces, one being in the direction of a side of the triangle. Thus, if F is one component, then F is numerically equal to P multiplied by the cosine of the angle PCF. In this manner it may be readily shown that the stresses in the sides of the triangle are of the nature of a tension, and therefore the rods forming the sides of the triangle may be replaced by flexible strings.



A better method is that of reciprocal figures. Thus draw the triangle, as shown at (I), making the vertical angle equal to 30°. Draw a line bisecting the vertical angle (representing the direction of P). As the magnitude of each of the three forces acting on the triangle is known, the directions of the remaining two can be obtained by means of a *reciprocal* figure, as at (II)—that is, make AB on any convenient scale to denote the magnitude of P. Then, as the two remaining forces are equal in magnitude, their directions are determined by making at (II) the equilateral triangle ABC. The three equal forces acting at the angular points of the triangle may be lettered as at (I). Finally, a letter is inserted in the interior of the triangle.

To obtain the nature and magnitude of the force in each of the three sides, we may commence with any of the given forces, and read off in (II) C to A. Next draw a line from A to D parallel to one side of the triangle, and a line from C parallel to the base. These determine by their point of intersection the point D. Reading the forces in the direction indicated, the diagram (II) shows that the forces in AD and DC are both tensile. In a similar manner, by joining D to B, we find that the force in the remaining side of the triangle is tensile. Hence it follows that the three rods forming the sides of the triangle may be replaced by strings.

Further, the lengths of the three lines AD, DB, and DC will give the magnitudes of the tensions in each of the three sides, and these may be obtained either by measurement or by calculation.

Quex.—This is all book work. The first part is given in Edwards's *Differential Calculus*, § 125. For the second part consult Price's *Differential Calculus*, second edition, § 129.

Tabby.—If $a + b + c + d = 0$, and $a^2 + b^2 + c^2 + d^2 = 0$, show that

$$\frac{a}{(b-c)(b-d)(c-d)} - \frac{b}{(a-c)(a-d)(c-d)} + \frac{c}{(a-b)(a-d)(b-d)} - \frac{d}{(a-b)(a-c)(b-c)} = \frac{-16abcd}{(a-b)(a-c)(a-d)(b-c)(b-d)(c-d)}.$$

(Sidney Sussex College, Cambridge, 1891.)

The left-hand side may be written

$$\frac{a(a-b)(a-c)(a-d) + b(b-a)(b-c)(b-d) + c(c-a)(c-b)(c-d) + d(d-a)(d-b)(d-c)}{(a-b)(a-c)(a-d)(b-c)(b-d)(c-d)}.$$

Now $a(a-b)(a-c)(a-d)$
$= a^4 - a^3(b+c+d) + a^2(bc+cd+bd) - abcd.$

But $(a+b+c+d) = 0$, therefore $(b+c+d) = -a$.

Also $a^2 + b^2 + c^2 + d^2 + 2(ab+ac+ad+bc+bd+cd) = 0$,
and $a^2 + b^2 + c^2 + d^2 = 0$.

$\therefore ab + ac + ad + bc + bd + cd = 0.$

$\therefore bc + bd + cd = -a(b+c+d).$

$\therefore bc + bd + cd = -a(-a) = a^2.$

Hence $a(a-b)(a-c)(a-d) = 3a^4 - abcd.$

Similarly, $b(b-a)(b-c)(b-d) = 3b^4 - abcd,$
$c(c-a)(c-b)(c-d) = 3c^4 - abcd,$
and $d(d-a)(d-b)(d-c) = 3d^4 - abcd.$

Hence the fraction to which the left-hand side reduces may be written—

$$\frac{3(a^4+b^4+c^4+d^4) - 4abcd}{(a-b)(a-c)(a-d)(b-c)(b-d)(c-d)}.$$

Again, $(a^2+b^2+c^2+d^2)^2 = 0.$

$\therefore a^4 + b^4 + c^4 + d^4 + 2(a^2b^2 + a^2c^2 + a^2d^2 + b^2c^2 + b^2d^2 + c^2d^2) = 0.$

But we have shown that

$(ab + ac + ad + bc + bd + cd)^2 = 0.$

$\therefore a^2b^2 + a^2c^2 + a^2d^2 + b^2c^2 + b^2d^2 + c^2d^2 + 2\{a^2(bc+bd+cd) + b^2(ac+ad+cd) + c^2(ab+ad+bd) + d^2(ab+ac+bc) + 3abcd\} = 0.$

$\therefore a^2b^2 + a^2c^2 + a^2d^2 + b^2c^2 + b^2d^2 + c^2d^2 = -2\{a^4+b^4+c^4+d^4+3abcd\}.$

$\therefore a^4 + b^4 + c^4 + d^4 - 4(a^4+b^4+c^4+d^4+3abcd) = 0.$

Hence $3(a^4+b^4+c^4+d^4) = -12abcd.$

$\therefore 3(a^4+b^4+c^4+d^4) - 4abcd = -16abcd.$

The left-hand side therefore reduces to the fraction

$$\frac{-16abcd}{(a-b)(a-c)(a-d)(b-c)(b-d)(c-d)}. \quad Q.E.D.$$

Arithmetical solution to query given last month.—Before the last $2\frac{2}{3}$ gallons of water were added, the cask stood,

18 gallons wine + $3\frac{1}{3}$ gallons water.

Since $2\frac{2}{3}$ is $\frac{2\frac{2}{3}}{24}$ or $\frac{1}{9}$ of the whole cask, it is clear that the 18 gallons wine + $3\frac{1}{3}$ gallons water form only $\frac{8}{9}$ of the total contents of the cask. Thus

before the *second* withdrawal the cask stood } $20\frac{1}{4}$ gallons wine + $3\frac{3}{4}$ gallons water.

This, of course, is the state of the contents *after* the *first* withdrawal, and after the addition of wine only; so that $6 - 3\frac{3}{4}$, or $2\frac{1}{4}$ *gallons of water*, were *taken* away at *first*. Thus the *fraction* of the whole contents removed at first must be this $\frac{2\frac{1}{4}}{6}$ or $\frac{3}{8}$.

$\therefore$ number of gallons of mixture removed at first
$= \frac{3}{8}$ of $24 = 9$ gallons.

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Latin Exercises. By A. E. Thomas, B.A., and the Rev. H. Gorse, M.A. It is some time since a book so full of errors has been submitted to us for review. Let us say at once that the sentences are well chosen and well graduated, and that if a book of this kind is needed, the one under review would do as well as any, so far as its subject-matter is concerned. But all concerned in its production seem to have conspired to render the book unreliable. On two pages that face each other (76 and 77) we have detected five errors—four in the marking of quantity, and one where a masculine noun of the second declension is given as neuter. In addition there are misprints and omissions, as well as downright errors in giving the Latin equivalents for English words.

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The Excelsior Alphabet Exercise Book, and Copy Books on Lettering, Parts I. and II., from the experienced hands of Frank Steeley, give the older and better known forms of the alphabet, as well as a sufficient number of pen-and-ink and other "fancy" alphabets to stimulate and direct original ideas. The copy books give more help in the formation of the letters, and both works afford opportunity for practice in the use of the "flexible point."

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ADAM AND CHARLES BLACK.

Rob Roy. Edited by A. T. Flux. We have already drawn attention to this useful edition of Scott, so we need only say that the present volume is edited in the same scholarly manner that characterised its predecessors.

Richard III. Edited by L. W. Lyde, M.A. The story of the play is given in the introduction, and this perhaps might have been omitted, so that the student could make his own running analysis of the play. The other parts of the introduction are very good, the play being regarded from a philosophical point of view. The notes are short and to the point, and they are collected at the end. This is a good feature, for the student's attention is not distracted from the text, as it would be by foot-notes, while the notes are easily found if required.

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Horace, Odes III. and IV. By John Sargeaunt, M.A. The above notice might almost be repeated for this book, so ably have the editors in each case done their duty. The introduction, however, to the present work deserves special mention for the sympathetic way in which Mr. Sargeaunt deals with the merits and defects of his author. The illustrations of statuary given in the book are exceedingly clear.

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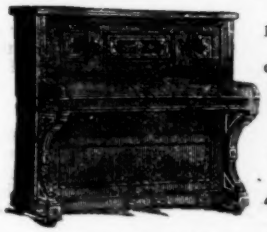

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man's indispensable duty to do all the service he can to his country." We think the work more suitable to this end than to its original purpose—a series of lectures to the girls of a high school. The scope of the work is ambitious, and resolves itself into a glance at the constitutions of the Greek and early Roman states, followed by a brief history of our own constitution. The writer seems to hark back to the Athenian polity as the ideal, and we think she is scarcely just in her estimate of our modern conceptions of communal duty when she passes such strictures as (page 20), "That a man or woman should carry on work for public rather than private advantage is regarded as a marvel." It must be remembered that we have to regard the political *ideals* of the ancients. These ideals are still ours. Even if we have not improved upon them, we may surely claim to have made an improvement in practice. For the rest, we may say that Miss Hodgson generally presents her thoughts with force and lucidity. The treatment of the development of the English State (chapters ii., iii., and iv.) is at once concise and artistic, and we particularly admire the antiquarian colouring which makes chapter ii. one of the most attractive parts of the book. Chapter v., which deals with the British Executive and the duties of its main departments, is especially clear and useful.

THOMAS MURBY.

Analysis of English History. (Century Edition.) By W. C. Pearce and Dr. S. Hague, LL.B. In these days a book on such a subject as history, designed for examination purposes pure and simple, is apt to receive scant courtesy at the hands of the critic. Such a work is our old friend *Pearce and Hague's Analysis*, which appears in smartened garb in this amplified edition. In spite of the prejudice against the cram-book, it must be said that this exhaustive, concise, handy, and well-arranged summary is a really useful work. Certificate candidates, who have to traverse the whole range of English history, would be well-advised in having at hand such a companion to their wider reading, and there can scarcely be a better book of its kind. The details, wondrous in their multitude, admit of easy reference. The matter is brought right up to date, and it is really remarkable to find that it is set down in a style that is quite interesting.

O. NEWMANN AND CO.

An English Grammar. By Rev. S. Claude Tickell. This book will suggest many useful thoughts to the teacher. We are pleased with the manner in which the author insists on the point that the relations exist between the words, and that inflections and relational words are simply the means of denoting these relations, and are not their cause. We are afraid, however, that the schemes and phraseology employed will not appeal to many teachers as likely to simplify the work of teaching grammar.

Object Lessons in Nature Study. (In two volumes.) By H. Major, B.A., B.Sc. It is only natural, when such a subject as nature study is supported by enthusiastic advocates, that text-books on the subject should appear for the use of teachers, but we are afraid that teachers will not get much help from the book before us. We are utterly at a loss to discover any plan on which the lessons have been drawn up. What in the name of common sense have lessons on a postman, a policeman, a soldier, and a sailor to do with nature study? True, in the lesson on the soldier we are told that "his 'trade' as a warrior must be thrust into the background," and "his weapons had better be ignored." After this we thought that the soldier was to be stripped, so as to be studied in a state of nature; but we are told that "his distinguishing *dress* may be illustrated by that of the policeman."

The *Object Lessons in Nature Study* contain also kindergarten lessons on form and colour, illustrated by "'wide' and 'narrow' desks," and "thick" and "thin" books, and the formation of capital letters—anything but nature.

When we turn to lessons whose titles are the names of natural objects, we find such sage remarks as "the sun goes to bed,' "is a 'lie-a-bed' in winter-time," "is a 'sleepy-head.'" We have such information about the snake's head as that it is "something like that of a fish, only not so large." Comment on such "nature study" is unnecessary. Some of the diagrams are good, others are very poor. The "coal-mine" is a geological marvel, and the illustration (Fig. 2) in the lesson on the snail conveys very little information in itself, and all reference letters have been omitted.

OLIPHANT, ANDERSON, AND FERRIER.

The Origin and Nature of Man. By S. B. G. M'Kinney, M.A. Part I.: Analysis. Those who believe with Pope "that the proper study of mankind is man" will find much to think over in this little book. The author is a careful and accurate thinker, who presents his ideas in clear and striking terms.

SIR ISAAC PITMAN AND SONS.

King Edward History Reader. The Introductory History of England. This is one of many successful attempts to compress into limits, and to tell in a style suitable to the requirements of Fourth Standard children, the story of England. It is only fair to say that this attempt is conspicuously enterprising. The matter is useful and interesting, the printing and arrangement excellent, and nearly every page contains a good picture. A good proportion of the pictures are coloured, and to good purpose. Great care has been taken to make the summaries and date-lists, which appear at the end, really useful, and the subject-matter is brought down to such recent date that his Majesty's Continental tour of Spring 1903 forms the concluding chapter.

THE RELIGIOUS TRACT SOCIETY.

Youth and Duty. By the Right Rev. J. E. C. Welldon, D.D. Apart from the school text-book and the adventure story, the schoolboy's literature occupies a very limited range. A volume of sermons for boys approaches the unique. Dr. Arnold's Rugby sermons of seventy years ago, so frequently alluded to in modern controversy, occupy an exalted place in our reference literature, but are in all probability little known to readers, old or young, at the present day. The work before us is one which may be placed in the hands of any enlightened, well-constituted youth, with almost the certainty of its finding its mark. *Youth and Duty* is the title given to a collection of sermons preached in the School Chapel at Harrow. There is a fine simplicity and directness of style, a dignified vigour of expression, and an appeal to the loftiest traditions of school life and the best side of boy nature which should make the book of use to any teacher of boys. The address entitled "The Sanctity of Reticence," which takes for its text 2 Kings ii. 3, may be specially instanced. We can well understand the affectionate remembrance of the broad and earnest teaching which moved Dr. Welldon's former pupils to request the publication of these sermons.

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The Antigone of Sophocles. Adapted by Elsie Fogerty. This is a good piece of work. For any one who wishes to gain some idea of a Greek play, and cannot study the original, we can confidently recommend this English adaptation. The language is suitable, and the rhythm of the poetry runs very smoothly, albeit not too monotonously. The illustrations are well drawn, and with the directions given in the introduction, should make the stage-manager's duty light where the play is going to be acted.

UNIVERSITY TUTORIAL PRESS.

Chaucer: The Prologue to the Canterbury Tales; The Nun's Priest's Tale. Edited by A. J. Wyatt, M.A. This portion of the *Canterbury Tales* is set for the London Intermediate Arts Examination, 1904. Mr. Wyatt has done his work with tenderness and care, as well as with every regard for the requirements of the student. The introduction gives a brief but clear account of the poet's life and works. The notes and glossaries are sufficient for their purpose, and the hint given in Appendix A should prove an aid to careful study. We are glad to see that Mr. Wyatt is inclined to side with the "newspaper-writers" in seeing a touch of Dan Chaucer's quaint humour in the well-known lines:—

> "And Frenssh she spak ful faire and fetishly,
> After the scole of Stratford-attë-Bowe,
> For Frenssh of Parys was to hire unknowe."

W. VERSLUYS, AMSTERDAM.

English for Continental Pupils. By J. Vellenga. In two parts. This work seems likely to be of great value to those for whom it is intended. It does not profess to teach the language "without a master," but it supplies the teacher of the English class with abundant material, and that of the right kind for practical use.

WILLIAMS AND NORGATE.

Phrases and Dialogues with Translations in Cape Dutch, Preceded by Short Grammatical Notes on the Latter Language. By J. F. Van Oordt, B.A. This is a handy little manual, likely to be of much practical use to those who are contemplating residence in any of our South African colonies. The writer and the printer have between them made sad hash of the English at times. Possibly "Cape English" has developed certain peculiarities, which may explain such words as "alright." The grammatical notes are of deep interest to one with only the

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slightest knowledge of what is in the title called "the latter language." They form an excellent lesson in philology, showing as they do the laws which govern the growth of language actively at work in the variations of Cape Dutch from the mother tongue. The arrangement of the book is practical and excellent in every way.

NEW GIFT-BOOKS.

W. AND R. CHAMBERS.

A Gay Charmer. A Story for Girls. By L. T. Meade. With eight illustrations by W. H. C. Groome. The name of L. T. Meade attached to a story gives immediate expectation of a bright, sparkling tale of girl-life, and those words just describe the present volume. In it we follow the home history and see pictured the opposite characters of two girls—Julia Cairns, the properly-brought-up and somewhat prim daughter of old-fashioned parents; and her cousin, Shirley Kendal, an altogether unconventional, fun-loving, daring, and brilliant girl, who has come to make a long stay at her uncle's home. It is, of course, the latter who is the "gay charmer" of the story, and her attractive ways soon produce a violent jealousy in her quiet cousin, who seeks, by any means, to underrate or destroy these attractions. Her method of accomplishing this, and the ultimate triumph of right and goodness depicted in the lives of these two girls and their companions, with all the heart-burnings, girlish plottings, and pleasures attendant, are skilfully drawn, and form an admirable story. It is handsomely bound, and the illustrations are effective.

Sibyl; or, Old School Friends. By May Baldwin. This story is a sequel to one, by the same author, entitled *A Popular Girl*. Its own interest, however, is in no way lessened by this. Sibyl Potter, the heroine, is the beautiful and impetuous daughter of an American millionaire. The wealth and position of her parents give to her entrance into "society," when she comes to London in company of her mother. Here her admirers are many, among them an English duke; and we are introduced to a wide circle of friends and acquaintances, whose characters and pursuits are well described. But there is a sudden change in the scene. The millionaire's riches vanish. We pass from mansion to cottage, from the society belle to the lady working for a living. Ere, however, the story ends, the clouds vanish, the sun shines again, and the duke reappears at the right moment. It is a well-planned story, abounding in clever and ofttimes humorous character delineation—one that will captivate all girl readers.

The Daughters of a Genius. A Story of Brave Behaviour. By Mrs. G. De Horne Vaizey. This is a quite engaging tale of four sisters, who, in consequence of the death of their father, are left, with two brothers, to make their way in the world. They are described by one of their cousins as "all geniuses;" but the story shows that their ability was due largely to their capacity for "taking pains." The struggles of each to gain a footing in her own department of literature and art are well set forth; and the various incidents attending those efforts, as well as the characters of the personages into whose company the sisters are brought, are very skilfully described. The book suggests sound advice to would-be aspirants to fame, and in altogether attractive and withal unobtrusive manner. There is, of course, some love-making in this very pretty and healthy story, two of the sisters coming, before its close, within sight of the orange blossoms.

Anthony Everton. By J. S. Fletcher. So long as there are many of those fellows with itching ears, who, like the watchman in this story, love naught so much as tales that savour of romance, so long will the stirring days of King Charles furnish material for boys' books. And when we consider the actual recorded history of those days, no adventure seems incredible. Mr. Fletcher has made the period his own, so far as the county of York is concerned, and the present story is founded on an episode in the career of Strafford when Lord President of the North. The hero, a young orphan wearying of his quiet life in the city of spurs, sets forth, as so many have done since, to see something of life in London; but his trustee, a scheming attorney, decides otherwise, and he finds himself entrapped in the house of one Master Habersham at York, with small prospect of going further. Now, Master Habersham is concerned with the lawyer and others in a plot against Strafford; and Anthony, discovering this, determines, with a true hero's disregard of difficulties and consequences, to confound their knavish tricks by giving warning to the Lord President. This, of course, he does, surmounting all difficulties, but, equally of course, he is plunged into further perils. Lost in the cellars of the conspirator's house, which are flooded by a sudden rising of the Ouse, it seems as though he were bound to perish and come to a fearful end. How that tragedy is averted readers must learn for themselves; and we are confident that no boy who follows the tale thus far will willingly go to bed with the last chapter unread. If he does, he won't sleep.

Peter the Pilgrim. By L. T. Meade, illustrated by Harold Copping. Mrs. Meade has in this new story made a novel application of Bunyan's *Pilgrim's Progress*. Little Peter of Pimlico spends a fortnight in the country as a "Holiday Funder;" and while there, his imagination quickened by the strange sights and sounds of nature, he falls under the spell of the great allegory, which is read to him by the girl who has been told off to "mother" him. The journey of Christian becomes the all-absorbing topic of his thoughts, and the burden of his delirium while in the accident ward at the hospital. By some means or other he manages to persuade his elder sister and a boy friend, who does odd jobs at Covent Garden, to set off with him for the Wicket Gate and the Palace Beautiful. The readiness of the city arab to go on such a pilgrimage puts a strain on one's credulity, and one also wonders how they manage to escape the Union. But such doubts will probably not occur to the young folks for whom the book has been so pleasantly written; and the farmer's unconscious impersonation of Mr. Interpreter, followed by Lady Dorothy as Charity, will be full of interest for them. The book is very suitable as a prize in the junior classes and for Sunday schools, and may perhaps lead some of its readers to make the acquaintance of the wonderful English of Bunyan himself.

Walsh the Wonder Worker. By George Manville Fenn, illustrated by W. H. C. Groome, R.B.A. Scientific experiments, for their own sake and apart from any practical result, have always had a strong fascination for the average boy, and an incidental explosion makes them irresistible. That "vulgarity of mind" to which an eminent astronomer recently attributed the utilitarian pursuit of science, and was promptly rebuked for so doing, does not, as a rule, interfere with a boy's enjoyment of what he familiarly calls "stinks." There is a decidedly chemical atmosphere about this book. Walsh is a chemist who takes a lonely country house, in order to elaborate a discovery which is to revolutionize the methods of lighting, heating, and locomotion; but he finds his secrecy threatened, not only by the youthful inquisitiveness of the sons of his two neighbours, but also by a rustic ignorance which considers all it does not understand to be witchcraft. He manages, however, to keep off all intruders, until a professional rival comes down in the guise of an innocent fisherman, and attempts to blow up the laboratory. Of course the boys turn up trumps, ignorance and envy are defeated, and the work is brought to a successful issue. The book is well written, full of incident and adventure, and will be thoroughly enjoyed by all boys with a taste for chemistry, fishing, and country life.

Sunset Rock. A Story for Girls. By May Baldwin, with illustrations by Harold Copping. The cover and the illustrations of this book suggest, to one who knows them well, the charm and wonder of Cornish seas and skies. Cornish breezes and Cornish fare enjoy a deserved reputation in the matter of restoring the physical health of jaded Londoners; but in this story they have much to do with the taming of London pride. Edith Everard, the spoilt child of a great London lawyer, gets herself into serious trouble at school, chiefly, according to her mistress, through helping a despised county council scholar "to try and speak correct grammar." She is expelled, and her father decides to send her away to his cousin at Burncoose. Cousin Patience lives in a simple cottage, and in an even simpler manner. Her ideal is to have all things in common, which is, unfortunately, more than an ideal with some of her neighbours, who diligently practise the precept at her expense. All this at first severely tries the proud young miss from town; but the example of her cousin's meekness and the companionship of three cheerful west-country maids soon bring out her better nature; and when danger comes, as it comes so often on those shores, that which while mere obstinacy has been her bane, when transformed into pluck and resolution makes her a heroine indeed. Nor must her young brother be forgotten. It is, perhaps, a commonplace to remark the influence of the younger on the young, but the charm of this particularly human boy would have melted a harder heart than his sister's. In the end the cure is so complete as to enable Edith to bear with equanimity the news that the poor scholar whom she had patronised was the long-lost heiress of an earl. We can only wish that other young persons afflicted with a like unseemly pride may find such a healthy and effectual remedy, with such a cousin and such a brother to lend their aid.

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CHURCH MISSIONARY SOCIETY.

Tufts and Tails; or, Walks and Talks with Chinese Children. By the Ven. Archdeacon Moule, of Mid China. This little work is of a somewhat exceptional character. It is evidently intended to interest young people in mission work, and is well calculated to accomplish that purpose, without the missionary element being made unduly prominent. Its author writes skilfully, and as one whose full experience enables him to describe accurately and graphically the scenes and pictures of Chinese life and character which many years' residence among the people has made him acquainted with. The illustrations are numerous, and portray Chinese ways and people in a most interesting and true-to-fact manner. Those relating to "Going to School in China" should be particularly interesting to teachers. The description of a pupil's first day at school is very novel. A good and useful book for the school library.

GINN AND CO.

Ways of the Six-footed. By Anna Botsford Comstock, B.S. The authoress's thorough knowledge of entomology enables her to choose stories of insect life from any corner of its domain she wishes. In this little book life-histories have been brought together to illustrate the broader and deeper things to be learned from animal life. Thus the history of a very conspicuous caterpillar introduces the readers to the subject of "warning colouration," under the homely title of "A Sheep in Wolf's Clothing."

Many of the stories told are by no means old, even to people of some scientific training, but all are told in such simple language as would make the book very suitable for a gift to a really thoughtful child in the upper standard. The subject-matter is rather above the common intelligence ministered to by the average reading-book.

The Insect Book. By Margaret Warner Morley. This little book has one good point in its humane and sensible advice to children as to how to treat insects. It is to be feared, however, that it has very grave faults. It is intended, apparently, as a reading-book for (to judge by its style) very fairly young children; yet a glossary at the end contains such damning words as Neuroptera and Ephemeridæ. The illustrations are by the authoress. Some are good, but many seem to sacrifice definiteness to picturesqueness.

A Little Brother to the Bear. By W. J. Long. The incidents recorded in these delightful sketches of animal life in the American backwoods have a freshness that places them far above the average animal story. The whole of the incidents are vouched for as having come under the writer's own observation, otherwise one could hardly credit animals with displaying intelligence so nearly human. The book is most profusely illustrated, every page being ornamented with artistic marginal sketches, which together with the splendid paper and printing render it an exceedingly handsome gift-book.

GRIFFITH, FARRAN, BROWNE, AND CO.

True Stories from French History. Compiled by N. M. Paul. New edition. The original edition, judging by the date of the author's preface, appeared first about thirteen years ago. A new chapter has now been added, and three other chapters rewritten. The work deals with thirty-five of the leading episodes of French history from the time of the Gauls and their rising under Vercingetorix against the Romans to the events of the Franco-Prussian War. The stories are well and interestingly told, and illustrated by many pictures. One of these depicts the great King Charlemagne examining the children of a school he had founded in his own palace, which suggests a then royal zeal for education which modern monarchs do not always emulate. The book is likely to create in young people a taste for history, and would make a good prize volume for a thoughtful boy or girl.

JARROLD AND SONS.

Billy Boy. A Story for Little People. By Mrs. Gerard Ford. This is a bright and prettily-told Anglo-Indian tale, introducing us to a charming little heroine, Tet, and a young urchin of a brother, known as Billy Boy. They lose their mother while yet quite little ones, and the story of her death is tenderly described. Tet soon becomes her little brother's guardian angel, and the adventures of the pair serve to delineate, and very attractively, the home-life and surroundings of English children in India. The story ends in England, giving opportunity for a very pleasing description of the incidents of the children's voyage from Bombay, and their first introduction to an English Christmas-tide. The book has six good illustrations by F. M. Cooper. Every little girl, we think, would like to make the acquaintance of Tet and Billy Boy.

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School Libraries.

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So many eloquent pens have already shown the importance of the school library as an adjunct to, and indeed as part and parcel of, the educational system, that it were a work of supererogation to insist upon that point further. But there is still something to be said on the question of the choice of books for the school library, and though, in this as in other matters, there is no use arguing about tastes, it is perhaps possible to set forth certain considerations that will meet with general approval.

* * * * *

The purpose of the school library being to foster a love of reading in children, and thus to widen their minds and help them to become intelligent and useful citizens, it is obvious that no success can be achieved unless the children are first *interested*. Now, in what are children interested? To begin with, in fairy tales and stories about children—the marvellous and the natural, which seem to them in no way inconsistent. What child has not revelled in *Grimm's Fairy Tales*, in Miss Sinclair's *Holiday House*, in Captain Marryat's *Children of the New Forest*? Then, as their circle of experience grows, they become interested in animals, in natural history, in voyages and discoveries; they form ideals, and cherish their favourite heroes, and reading about these, they are drawn on to read the romance of history generally. It is at this period that such books as Anson's and Cook's *Voyages*, *Robinson Crusoe*, Waterton's *Wanderings*, and Southey's *Life of Nelson* make a strong appeal. With still wider knowledge, the boys and girls towards the end of school life begin to take an interest in the literature of ideas: then Addison's *Spectator* and Macaulay's *Essays* open a world of thought to them, and they are helped towards the formation of a critical taste.

* * * * *

It may be objected that some of the books mentioned, and others of their class, not having been specially written for children, are unsuited for school libraries. But this is to show a mistaken view both of the object of education and of the nature of children. Children have a great objection to be written down to, and much that is composed specially for them is washy, and devoid of real stimulus and force. Their imagining and thinking cover a wider range than many adults imagine. A boy of six was taken to see a performance of the *Merchant of Venice*. He was much struck by it, and nothing pleased him better afterwards than to hear the story of the play from Lamb's *Tales*. A girl of eleven was one day discovered by her father engrossed in *Jane Eyre*, and though there are many things in *Jane Eyre* that a child cannot, and should not, understand, the total impression made by the book was all for good. The great point is that *children who grow up with the best will never care for the worst*; good reading is the foundation of taste.

* * * * *

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* * * * *

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